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SYPHILIS OF THE STOMACH

WITH SPECIAL REFERENCE TO ERRORS IN DIAGNOSIS*

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WITHIN a period of less than two decades the number of reported cases of syphilis of the stomach has increased tremendously. Whereas formerly to encounter one case of gastric lues was considered a unique experience, in recent years the observation of several cases by one individual is looked upon as nothing remarkable. LeWald[1] in collaboration with Downes in 1915 reported from the radiologic standpoint 8 cases of gastric syphilis. A subsequent report[2] which appeared in 1923 included 50 cases with radiologic deformity of the stomach suggestive of a syphilitic lesion. Thirty of these were associated with a positive Wassermann reaction and were considered "without doubt true cases of congenital or acquired syphilis of the stomach." Eusterman's[3] first publication on the subject which appeared in 1917 was based on 23 cases. In 1930 this number had increased[4] to 93. Bockus and Bank[5] in 1929 reported 23 cases of gastroduodenal disease associated with syphilis. A certain number of this series were considered cases of gastric lues. In the past decade we have observed 18 syphilitic stomachs, 10 of which were studied from the morphological standpoint and the diagnosis established by this means.[6] In addition to the authors already quoted the literature abounds with reports of smaller series of cases from various portions of the globe.

The increased frequency with which the diagnosis of gastric syphilis is made is due to several factors. The more or less routine use of the Wassermann test has led to the discovery of unsuspected lues and this in turn to the consideration and ultimate diagnosis of syphilis of the stomach. The general utilization of the *x*-ray in the presence of gastric symptoms has similarly been the basis for the revelation of evidence pointing to luetic lesions. The more frequent application of antiluetic treatment as a therapeutic test has also led to the final conclusion of gastric syphilis in certain cases where previously inoperable carcinoma for instance was diagnosed. The advances in surgery which have rendered laparotomy relative safe have also contributed through exploration to the disclosure of additional instances of syphilis of the stomach. Besides these diagnostic aids the increased consciousness and knowledge of gastric syphilis have in a measure been responsible for the greater frequency

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with which the affection is reported. The oft-quoted statement, "The apparent frequency of any disease often keeps pace with the increasing knowledge relative thereto," is quite applicable to gastric syphilis.

From reading the literature one gains the impression that with our present armamentarium, more especially the aids already mentioned, the diagnosis of syphilis is relatively simple. This view is supported by the rather small number of cases published from the standpoint of errors in diagnosis. The enormous series of 93 cases reported by Eusterman[4] in which all the patients were followed for at least two years does not include a single instance of erroneous diagnosis. LeWald[2] mentions in a series of 50 cases with *x*-ray deformity suggestive of a syphilitic lesion that 3 at post mortem were found to have carcinomatous lesions of the stomach. Bockus and Bank[5] in their series of 23 cases of upper gastrointestinal disease associated with syphilis, mention 3 cases of carcinoma, 2 of which were apparently mistaken for syphilis. Luria[7] in his monograph on gastric lues mentions but one case in which a gastric lesion was assumed to be syphilitic and was subsequently proved to be carcinomatous. Harris and Youmans[8] in a series of 7 cases report that in only one of them was the ultimate diagnosis based upon the anatomic features of the resected specimen open to question. Gatewood and Kolodny[9] mention a patient with a positive Wassermann reaction and extensive gastric involvement who improved for a time with antiluetic treatment but showed at autopsy a gastric malignancy. Aside from the cases of possible or probable errors in diagnosis mentioned, only a few isolated instances of erroneous diagnosis are reported. Since the cases judged to be gastric lues are being recorded with increasing frequency and the number of incorrect diagnoses in follow-up publications is so small, it is to be inferred that mistakes are relatively uncommon.

From a critical analysis of the recorded cases and personal observations in our own and other hospitals we have gained the impression that the diagnosis of gastric lues is not as simple as most writers lead one to believe. The same aids which have led to the increased recognition of syphilis of the stomach are responsible for many erroneous diagnoses. This statement, although applicable to all the measures mentioned, is particularly true with regard to the Wassermann test. A positive complement-fixation test in the presence of radiographic evidence of a gastric lesion immediately leads to the suspicion of syphilis of the stomach. It is to be borne constantly in mind that the prevalence of syphilis is such that the coexistence of non-specific gastric lesions and constitutional lues should be expected to occur quite frequently. In the Cook County Hospital the incidence of lues is 10 per cent. LeNoir[10] points out that in Paris the number of certain or probable syphilitics in general medical statistics is a little more than 20 per cent. Fitts[11] in discussing the subject of gastric lues states that among southern negroes the Wassermann test is strongly positive in 30 per cent and that clinical lues is present in 75 per cent. As one might anticipate, the independent association of constitutional syphilis and a non-specific lesion of the stomach is more frequently encountered than constitutional and gastric syphilis. Windholz[12] in an investigation involving 13,680 autopsies found evidence of syphilis in 386 cases, 20 of which showed morphological changes in the stomach. Of these 20 cases only 2 were examples of gastric syphilis. Hill[13] in a study at the Charity Hospital in New Orleans found among 228 patients with demonstrable gastric lesions strong evidence of syphilis in 22. Of these 22 patients with both lesions of the stomach and lues, 5 were classified as instances of probable gastric syphilis. The same writer in a review of a series of 1300 luetics and 150 patients with definable gastric lesions observed at the Touro Infirmary found 12 to have both a positive Wassermann

reaction and *x*-ray changes of the stomach. In no case, the author concludes, was the evidence sufficient to justify the diagnosis of gastric lues. Just as the serologic test may mislead the clinician the other adjuvants in diagnosis which have been mentioned i.e., the *x*-ray, the therapeutic test, exploration and the knowledge of the significant features of the affection, may prove deceptive.

Although we do not consider syphilis of the stomach a rare disease (see Singer and Meyer[6c]) we are inclined to doubt the high incidence suggested by the number of reported cases. We believe that the affection is frequently mistaken for other lesions and that a large proportion of the cases in the literature if critically analyzed and closely followed would prove incorrect. One group of cases erroneously considered to be lues of the stomach is comprised of atypical gastric malignancies which are reported prematurely. It is a deplorable circumstance that either the cases are not followed for a sufficient length of time or after the correct diagnosis is made no subsequent report of the error is published. The seriousness of overlooking a carcinoma in its early stage requires no expatiation. The danger of permitting a malignancy to remain in the body, together with the difficulty in discriminating between gastric carcinoma and lues, has led several observers (Aoyama,[14] Baumecker,[15] Schlesinger,[16] Strauss[17]) to recommend exploratory laparotomy in all cases or at least wherever the slightest suspicion of carcinoma is to be entertained. A second group of cases reported as luetic represent benign lesions which are associated with constitutional syphilis. The response to specific therapy is usually the basis for arriving at the diagnosis of gastric lues. However, as Hartwell[18] has emphasized, improvement even in non-specific cases following the use of arsenic is quite common.

The simultaneous presence of gastric syphilis and a non-specific benign or malignant lesion of the stomach, so-called hybrid form, merits consideration. The independent occurrence of two such affections on the basis of statistics would be manifestly rare. However, the concomitance of syphilis and carcinoma may not be entirely accidental. Totzky[19] in a recent review of the literature adduces a great deal of evidence indicating a causal relationship between syphilis and carcinoma. He appends a case which he considers an instance of malignancy developing from a syphilitic gastritis. He also quotes Pauchet-Hirschberg as assigning to syphilis an important role in the etiology of gastric carcinoma. The evidence offered by Totzky applies mainly to carcinoma of the tongue and mouth. Malignancies of these structures are related by the author to the frequent occurrence of leucoplakia which is regarded as a precursor. Windholz[12] in discussing the subject of gastric carcinoma in syphilitics refers to the association of malignancy of the vagina and syphilitic leucoplakia. It is of interest and may be of significance that although no special search was made, in two of the cases of syphilis of the stomach reported by the authors[6d,e] (see also Singer[20]) leucoplakia of the gastric mucous membrane was found.

In order to illustrate the difficulty at times and some of the pitfalls in the diagnosis of gastric lues we have selected 7 cases which have come under our observation. In each instance the preliminary diagnosis of syphilis of the stomach was erroneously made either by us or by others. In some of the cases a skeptical and critical attitude resulted in detection of the mistake. In the other instances the ultimate outcome and pathological examination of the lesion were the means of discovering the true nature of the affection. The cases referred to divide themselves into the two groups mentioned, i.e., malignant and benign. The consequences of mistaking a carcinomatous for a syphilitic lesion are so serious that it was deemed advisable to discuss several examples of this type.

GROUP I. GASTRIC SYPHILIS MISTAKEN FOR CARCINOMA OF THE STOMACH

Case 1. J. B., a white man, was first seen by us October 17, 1925 at which time the patient was forty-two years of age. His chief complaint was upper abdominal pain which had been present for three weeks and was growing progressively worse. The onset of his pain was rather abrupt and was associated with vomiting which persisted for two or three days and then disappeared. No other significant information was obtained except for the history of conjugal lues and a sterile marriage. The outstanding physical observation was a palpable mass in the left hypochondrium. The Ewald meal showed no free acidity. There was no anemia, the red blood count being 5,200,000, the hemoglobin 90 per cent. The blood Wassermann reaction was one plus. An *x*-ray examination disclosed a filling defect of the stomach corresponding to the location of the palpable mass. The defect was situated posterior y in the cardiac end of the stomach and measured 8 to 9 cm. in diameter. The diagnosis of carcinoma of the stomach was made without reservation. Laparotomy was performed in the presence of several consultants. A hard mass which extended along the posterior wall and fixed the stomach was palpated and considered malignant. No attempt at removal was made.

Following the operation the abdominal pain disappeared completely. The patient persisted in getting out of bed early in the postoperative course and developed a herniation. Through the thin hernial sac it was relatively easy to palpate the tumor. The patient left the hospital to convalesce at a spa. While there he visited a clinic where he received treatment for lues which was suspected on the basis of the one plus Wassermann. Later a herniotomy was recommended. At the time of the repair of the postoperative rupture, exploration of the abdominal contents according to the surgeon failed to disclose the presence of a tumor of the stomach. The patient recovered his strength rapidly, his abdominal symptoms disappeared and he began to feel as well as ever. He maintained his health for a period of a year during which time he was actively engaged in carrying on his business.

About November 15, 1926 the patient again began to suffer from upper abdominal pain and vomiting. The pain was made up of two components, a dull, mild, more or less continuous one and a rather severe, sharp, intermittent one. The sharp, intermittent pain, which usually lasted a few hours, was associated with vomiting of a persistent character. We were again consulted by the patient and his family physician. No tumor was palpable at this time. There was no evidence of emaciation or anemia. A neurological examination was negative for signs of tabes. An *x*-ray examination of the stomach failed to demonstrate the defect noted in the initial examination. Instead, a smooth, concentric narrowing of the pars media of the stomach was visible. The blood Wassermann was now negative. Because of the apparent disappearance of the original tumor, the complete remission for a year, the lack of emaciation or anemia, and the anomalous deformity noted in the recent roentgen examination we suggested the diagnosis of gastric lues. The history of conjugal syphilis and the improvement occurring simultaneously with a course of antiluetic treatment, we felt, lent support to the diagnosis. Specific therapy was therefore recommended.

The patient chose to leave Chicago and to return to Germany. He was therefore referred to Prof. Friedrich von Müller of Munich to whom a copy of the clinical observations and *x*-ray films were forwarded. Following a period of observation, consultation was held with Prof. Sauerbruch and operation decided upon. At this time the patient's clinical picture had changed very decidedly. His pain had become persistent and quite severe, and the loss of flesh, strength and color was apparent. On March 2, 1927 the patient was relaparotomized by Prof. Sauerbruch whose description of the operative observations and procedure reads: "The stomach, transverse colon and the pancreas were densely agglutinated to form a tumor mass the size of a child's head. The tumor involved almost the entire length of the stomach. In the face of the extensive involvement it was impossible to perform even a gastroenterostomy. The operation was therefore concluded as an exploratory laparotomy." The patient died shortly following operation with the symptoms of cachexia.

Case 11. J. K., a white man of fifty-three, was admitted to the Cook County Hospital November 17, 1927 with an entrance room diagnosis of peptic ulcer. He stated that for many years he experienced heartburn following certain irritating articles of diet and after

excessive smoking. Four months prior to entrance he began to suffer from epigastric fulness and heaviness occurring shortly after the intake of food. Spontaneous vomiting had not occurred. Soda which afforded relief whenever heartburn appeared was not effective in ameliorating the recent epigastric discomfort. Emesis induced by digital irritation of the pharynx had been resorted to occasionally with gratifying results. The patient's appetite was somewhat impaired but his strength retained. A weight loss of 15 lbs. had occurred during the four months of illness.

The physical examination was essentially negative except for signs of a high-grade emphysema. No distinct mass was palpable but a sense of resistance was encountered in the left hypochondrium. There was no epigastric tenderness. Investigation of the blood revealed no anemia. The Ewald meal yielded 10° free and 22° total acidity. Stools were positive for blood in approximately 50 per cent of the specimens tested. The Wassermann reaction was reported four plus. The *x*-ray examination disclosed a rather regular, cylindrical deformity of the pars media of the stomach interpreted as the result of an annular constricting lesion of syphilitic or malignant origin. The patient was placed on antiluetic treatment and a bland diet with hydrochloric acid prescribed. A notable improvement followed and after a month of treatment the patient was discharged with instructions to continue with specific therapy.

In the latter part of February, 1928 the patient sought financial aid from the social service department of the Hospital and was referred to the follow-up gastrointestinal clinic for a report of his physical state. It was at this time that we personally interviewed and examined the patient for the first time. We learned that since leaving the hospital he had continued with his antiluetic treatment at a free dispensary and had gained in weight and returned to work as a gardener. He had adhered to a bland diet until recently when on account of lack of work and funds he was unable to obtain the prescribed articles of food. He attributed his recurrence of symptoms to an inadequate diet and on this account endeavored to obtain financial help. Physical examination disclosed a slight degree of pallor and a suggestive mass to the left of the midline. An *x*-ray examination on March 1, 1928 showed essentially the same type of deformity as seen three and one-half months previously.

After a consideration of the past and present observations we decided that the presence of a carcinoma could not be excluded and therefore recommended laparotomy. The patient was operated upon March 8, 1928 at which time there was found a carcinoma involving the pars media extending toward the pylorus. Metastatic deposits were present in the lesser and greater omentums. A biopsy specimen was reported adenocarcinoma. A posterior gastroenterostomy was performed. The patient recovered from the operation but within six weeks began to lose ground. He died five months after the operation with a distinct picture of abdominal carcinomatosis.

Case III. F. S., a white man of forty, applied for admission to the Cook County Hospital on September 4, 1929. His complaints upon entrance were epigastric distress, vomiting and loss of weight and strength. The duration of his illness was three and one-half months. The distress was described as a sense of fulness which occurred immediately after meals and continued for an hour or two. No pain was felt during periods of fasting or following emesis. Vomiting occurred unless the amount of food taken at one meal was greatly curtailed. The vomitus consisted of food ingested immediately prior to the ejection. Milk when vomited was returned in a coagulated state. The loss of weight and strength although only of moderate degree were progressive. The only other pertinent fact in the history was the development of a chancre at the age of thirty-two and a brief course of antiluetic treatment. The physical examination disclosed evidence of some loss of weight but no apparent anemia. A sense of resistance was felt in the epigastrium, but no clearly definable mass could be discerned. The Ewald test meal contained no free and 8° of combined acidity. Of five stools four were negative for occult blood. The blood Wassermann reaction was reported four plus. The radiological examination confirmed the clinical diagnosis of leather-bottle stomach.

Because of the positive Wassermann reaction and the suspicion of gastric lues which it provoked we were consulted regarding the diagnosis. We favored the presence of carcinoma of the stomach because of the short duration of the illness and the higher incidence of malignant as compared with luetic linitis plastica. The attending surgeon to whom the

patient was assigned decided to explore and performed a laparotomy September 12, 1929. The entire stomach was found greatly contracted and uniformly thickened. The serosa was opaque and lusterless due to a fibrous increase. There were adhesions over both surfaces of the stomach especially marked along the curvatures. No gross evidence of tumor was detected on the surface of the stomach or in the perigastric glands. The liver (Fig. 1) contained numerous irregular depressed scars involving particularly the left lobe and the hepatic margin. The operator considered the gastric lesion and the scars of the liver to be syphilitic. We were inclined toward the same opinion but on account of the diffuse character of the lesion we suggested a biopsy to rule out a scirrhous carcinoma. The surgeon proceeded to perform a posterior gastroenterostomy in the process of which the thickening of the gastric wall was seen to be due mainly to an increase in the submucosa which appeared fibrous in character. Our suggestion to remove a block of tissue for biopsy was not followed.

Fig. 1. Case III. Depressed, stellate scars of liver involving mainly left lobe and anterior border of right. Posterior aspect of left lobe, which is curled on itself, is indicated by an arrow. Scars at operation were considered specific in origin and lent support to diagnosis of syphilitic linitis plastica of stomach. Microscopic sections obtained at subsequent autopsy showed stomach to be seat of a scirrhous carcinoma and liver to be involved by metastases with desmoplastic properties.

The patient recovered from the operation but on the fourth postoperative day developed fever and subsequently symptoms and physical evidences of a bronchopneumonia which proved fatal. The autopsy performed the day of death which was a week following operation disclosed in addition to the changes described in the stomach and liver, a bilateral confluent bronchopneumonia and a localized fibrinous peritonitis. Microscopic examination of the stomach showed the presence of a fibrosclerosing carcinoma. The scars in the liver were due to metastatic deposits which through their desmoplastic properties had led to cicatricial contraction.

Fig. 2. Case IV. Roentgenogram of stomach in woman thirty-six years of age who was treated three months previously for peptic ulcer but without success. The dumb-bell type of deformity led to a suspicion of syphilis which was corroborated at operation. Specific therapy led to temporary improvement. Relaparotomy disclosed a far-advanced carcinoma.

Case IV. M. W., an actress, thirty-six years of age, was referred to us by a surgical colleague on September 15, 1931. The history of the patient's illness dated back to the spring of 1929 when for two months she suffered from epigastric distress on the order of hunger pains. She then felt well for a year when in the spring of 1930 the hunger pains recurred accompanied this time by heartburn. Modification of the diet and a few alkaline powders soon led to a cessation of symptoms. The third attack which occurred in March, 1931, differed from the previous ones in that the discomfort now amounted to a pain which radiated from the epigastrium to the back. She was seen by a physician in San Francisco where she was performing and the condition was diagnosed as penetrating ulcer. An ambulatory management consisting of a milk diet and powders was instituted. Only partial relief attended the treatment. The patient completed

her contract and returned to her doctor in Chicago with whom she had been corresponding.

Reexamination of the patient's stomach with the aid of a barium meal on May 18, 1931 disclosed a dumb-bell deformity of the stomach (Fig. 2). This was interpreted as the result of scar tissue contraction occasioned by a penetrating ulcer. Exploration was undertaken after a few days of preparation and an hour-glass stomach encountered. The mid-gastric mass causing the constriction was smooth and tubuar having neither a crater to suggest the presence of an ulcer or the firmness or infiltrative character of a carcinoma. The stomach was easily delivered. The surgeon, who was well acquainted with the patient's past history, concluded that he was dealing with a luetic lesion and attempted nothing further. The patient was placed upon antiluetic treatment (mercury and iodides) and improved rapidly. She returned to work for the summer months during which time she performed regularly and received specific therapy.

The patient had apparently fully recovered her health when about the middle of August a gluteal abscess developed following an injection of mercury. Although this was effectively treated by incision and drainage the patient failed to recover her strength and began to suffer from pain and vomiting. An *x*-ray examination made September 9, 1931 showed an extensive, irregular defect involving the pars media of the stomach. The surgeon who had treated and operated on the patient referred her to us for an opinion. We elicited the information that the pain during the month prior to the date of interview, September 15, 1931, was more or less persistent and felt more in the dorsal than in the ventral region. Also that vomiting which had been present for approximately three weeks had ceased during the last few days. The Wassermann reaction, we were informed, had never been positive. The patient was quite obese. Abdominal palpation was unsatisfactory on account of the thick panniculus. There was a moderate secondary anemia. We interpreted the lesion in the several series of *x*-rays as due to an annular constricting carcinoma. What were interpreted as ulcer niches in the original series we considered to be excavations within and incidental to the filling defects.

On account of the extent of the lesion and the degree of obesity we considered the prospect of surgical cure a rather bleak one, and expressed this view to the patient's relatives. Another surgeon who was consulted held out more hope and was chosen to perform the operation. The following information was obtained from the surgeon who referred the patient to us. The patient was prepared by a blood transfusion and operated upon September 22, 1931. A growth was found involving the pars media extending proximally along the lesser curvature. An extensive resection was performed on the assumption that the lesion was malignant. The patient failed to rally and died in spite of further blood transfusion within a few hours of the conclusion of the operation. The microscopic diagnosis of the resected specimen was adenocarcinoma.

GROUP II. GASTRIC SYPHILIS MISTAKEN FOR NON-SPECIFIC BENIGN AFFECTIONS OF THE STOMACH

Case v. *An unrecognized perforation of a peptic ulcer producing perigastritis with a resultant anomalous roentgen deformity.* S. E., a white man of fifty-nine, entered the medical service of the Cook County Hospital on December 16, 1930 with an admission diagnosis of gastrointestinal malignancy. The history as recorded in the hospital record stated that the patient's illness was of eight weeks' duration. At the onset of his difficulty he experienced epigastric distress which occurred fifteen minutes after meals and continued for two to three hours. About four weeks after the onset the pain became suddenly worse, forcing the patient to take to bed and to require morphine for relief. After several days the severe pain subsided but a residual soreness remained. During the three weeks prior to entrance the patient restricted his diet both quantitatively and qualitatively. Within the twenty-one days he lost about 20 pounds in weight and noted a progressive decrease in strength. He denied venereal disease.

Physically the patient appeared emaciated but not anemic. A mass with indefinite outlines was palpated in the epigastrium. The Ewald test meal yielded 60 c.c. of gastric contents having a free acidity of 11° and a total of 33°. Of two stools which were examined one gave a positive test for occult blood. The assumption that the patient was suffering from a gastric carcinoma seemed to be supported by the *x*-ray observations (Fig. 3), which were recorded as follows: There is a constant deformity of the prepyloric portion of the stomach

and a rigid, jagged lesser curvature in the pars media. The duodenal bulb appears flattened but is not otherwise defective. However, a placed on medical management for ulcer without antiluetic therapy and gained rapidly both in weight and strength. He was discharged

Fig. 3.

Fig. 4.

Fig. 3. Case v. Serrated lesser curvature with prepyloric irregularity and narrowing, thought to be due to syphilis. A careful history elicited information indicating antecedent occurrence of perforation of a peptic ulcer, with spontaneous recovery and resulting perigastritis.

Fig. 4. Case vi. Atypical defect of the pars pylorica ascribed to syphilis. The deformity illustrated was constant fluoroscopically and in a series of films. After two weeks of intensive antisyphilitic treatment notable subjective improvement occurred. The etiology of the deformity was subsequently ascertained to be corrosive poisoning of the stomach.

two plus Kahn reaction and spontaneous improvement during the first few days of hospitalization led to the diagnosis of gastric lues.

Because of our interest in syphilis of the stomach we were apprized of the case and invited to pass an opinion. In questioning the patient carefully we obtained a typical history of ulcer distress which had been present periodically for several years. Eight weeks prior to admission a recrudescence occurred which culminated in an intense, annihilating pain which awakened the patient one morning about a month before admission. The details of the onset and subsequent course were characteristic of a perforated peptic ulcer which had become sealed spontaneously (see Singer and Vaughan[21]). We were able to show fluoroscopically that the lesion was not rigid or absolutely constant and that the deformity had the character of one due to adhesions. Following our suggestion the patient was from the hospital January 15, 1931, entirely well. On customary medical management for ulcer he has continued free from symptoms to date.

Case vi. *Annular constricting lesion of the pars pylorica due to antecedent corrosive poisoning associated with a positive Wassermann reaction and improvement under specific therapy.* J. C., a white man of sixty, was referred to the Dispensary of the University of Illinois College of Medicine May 26, 1931 on account of epigastric distress which had been present three years. The discomfort was described as an ache which generally followed one-half to one hour after meals. The distress was not relieved by food or soda but was often alleviated by vomiting which was self-induced. About a week previously the patient, who was a periodic drinker, began to suffer an aggravation of symptoms following an alcoholic debauche. In addition to his epigastric distress and vomiting, he noted substernal soreness

upon swallowing which he attributed to the forceful passage of a stomach tube during his state of inebriety. He acknowledged repeated gonorrheal infections and a chancre 30 years prior for which he had received merely local treatment. An inventory of symptoms yielded the fact that he had suffered from lightning pains in the legs for more than four years.

Upon physical examination except for moderate emaciation and slight tenderness in the epigastrium no noteworthy abnormality was demonstrated. The Ewald test meal contained no free and 8° total acidity. The Wassermann and Kahn tests were reported four plus. The blood examination showed a normal red count and hemoglobin determination. The *x*-ray (Fig. 4) demonstrated an atypical, annular constricting lesion of the pars pylorica which was regarded as the result of an infiltrative growth. The diagnosis of gastric lues readily suggested itself and the patient was placed upon antiluetic treatment. After two weeks of intensive therapy the patient improved considerably. At this time we had occasion to see the patient and agreed tentatively with the diagnosis of gastric lues. However, the request was made to hospitalize the patient for a period before final judgment was passed.

On June 10, 1931 the patient was admitted to the medical service of the Cook County Hospital for further study. An *x*-ray taken shortly after entrance (June 12, 1931) demonstrated that the prepyloric constriction had become more marked. The change in the roentgen appearance was occasioned, it was thought, by the antiluetic treatment. At this juncture it appeared as though all the requirements for the clinical diagnosis were fulfilled and that this was a *bona fide* case of gastric syphilis. Careful perusal of the history, however, led us to investigate the possibility of corrosive poisoning of the stomach which it was thought might explain the radiologic observations and the physical improvement of the patient (see Boikan and Singer[22]). Accordingly, we obtained the name and communicated with the physician who lavaged the stomach of the patient immediately preceding the latter's aggravation of symptoms. We learned that during his state of intoxication the patient had drunk formaldehyde which was discovered by friends who summoned the physician. This information had not been imparted to the patient.

Fig. 5.

Fig. 6.

Fig. 5. Case vii. Huge ulcer niche involving greater portion of lesser curvature in a known tabetic who had been under specific treatment for two years. Lesion was originally believed to be syphilitic in origin.

Fig. 6. Case vii. Appearance of stomach shown in Figure 5, seventy-three days after modified Sippy management was instituted and antiluetic therapy was discontinued. Gastric defect has shrunk to less than half its original size. Deformity of duodenal bulb is plainly visualized.

Case vii. *Huge ulcer of the lesser curvature in a known tabetic with a positive Wassermann reaction. Simple ulcer management without antiluetic treatment led to a disappearance of the lesion.* J. A. B., a white man fifty-one years of age, was admitted to the neurological service of the Cook County Hospital on May 18, 1929. The complaints elicited were referable chiefly to tabes dorsalis in the ataxic stage. The patient had contracted lues in 1914 and received treatment two months after the appearance of the initial lesion. Although he had been under constant treatment for two years prior to entrance his blood Wassermann reaction was found to be two plus and his spinal fluid Wassermann reaction four plus. He received specific therapy while in the ward and was discharged June 28, 1929 in practically the same physical condition.

Fig. 7. Case vii. Roentgenogram of stomach three and one-half months after Figure 5 and one month after Figure 6. Excavation on lesser curvature has completely disappeared. Fluoroscopically a convergence of rugous folds toward middle of lesser curvature was demonstrable. Final diagnosis was peptic ulcer of non-specific character.

He reentered the hospital July 15, 1929 at which time he emphasized the presence of upper abdominal pain, pallor, weakness and loss of weight. The abdominal pain possessed the characteristics of peptic ulcer, being periodic and rhythmic in nature. He had noted its presence for several years. However, the pallor, loss of weight and strength were of relatively recent origin. Following an Ewald meal 100 c.c. of gastric contents with a free of 40° and a total acidity of 60° were recovered. A barium meal on July 23, 1929 demonstrated a huge niche (Fig. 5) on the lesser curvature side of the stomach. The attending physician to whom the patient was assigned considered the defect too large for a simple peptic ulcer and in view of the presence of lues diagnosed the lesion as syphilitic. When the patient was demonstrated to us we asked for permission to investigate the nature of the gastric affection.

We assumed charge of the patient and immediately discontinued the antiluetic treatment and the anti-anemic diet which the patient had received heretofore without benefit. Modified Sippy treatment for ulcer was instituted following which the patient began to improve in color, weight and strength. Subsequent *x*-ray examinations of the stomach showed a progressive diminution in the size of the gastric niche and also what was interpreted as the deformity of a duodenal ulcer. The patient was discharged August 20, 1929 physically fit to continue his work as an accountant. He returned to the follow-up Clinic for further treatment and for radiologic observation. A decrease in the size of the lesion was consistently noted (see Fig. 6) until on November 8, 1929, three and one-half months following the institution of ulcer therapy and the discontinuance of antiluetic treatment, the niche was no longer visible (Fig. 7).

SUMMARY AND COMMENT

Recent studies of various phases of gastric syphilis point to the view that the affection is not nearly as uncommon as was formerly believed. The introduction and general employment of such valuable aids as the Wassermann reaction, the *x*-ray, the therapeutic test and exploratory laparotomy render the clinical recognition of the disease in a large percentage of cases relatively easy. Nevertheless, on account of the high incidence of syphilis and the frequency of non-specific as compared with specific lesions the diagnosis of gastric lues must be made with a great deal of circumspection. Our own observations and our knowledge of the literature has led us to believe that the clinical diagnosis of

syphilis of the stomach is made more frequently erroneously than correctly.

A series of 7 illustrative cases in which gastric lues was mistaken for other maladies has been selected from our records. In some instances the error was committed by us and in other instances by our colleagues. Four cases proved to be malignancies, three mid-gastric and one diffuse. The other three cases represented benign, non-specific lesions. One was the result of a perigastritis occasioned by an unrecognized perforated ulcer. Another was the consequence of ingestion of a corrosive during a state of inebriety. A third lesion was a huge excavation in a known tabetic which disappeared following the substitution of simple ulcer for antiluetic treatment. It is quite possible, although not likely, that in one or more instances true luetic changes coexisted with the non-specific affections of the stomach.

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TRAUMATIC PEPTIC ULCER

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THERE seems to be a great uncertainty regarding the true existence of a peptic ulcer following upon trauma. Authorities seem divided, some expressing an affirmative opinion; this opinion is based not upon any personal experience, but upon a perusal of past literary references. Those that presume to deny its existence usually do so with a sweeping gesture, and frequently without due care and deliberation before an expression of doubt.

In this country particularly, at least in so far as the literature is concerned, there seems to be very little first-hand experience with the entire subject. European literature on the other hand, particularly the French, seems to have collected a fairly large series of cases, though some of these cases antedate the period of radiographic studies of the stomach, and some of the cases occurred before the recognition of duodenal ulcer. Yet anyone fair-minded or open-minded who studies such literature must soon feel convinced of the possibility, if not the actual existence, of a peptic ulcer following upon a severe abdominal trauma.

In a textbook on diseases of the stomach by Ewald,[1] published in 1897, the subject is considered. He quoted Leube's[2] experience with a case of a typical gastric ulcer developing after a blow upon the epigastrium by the shaft of a wagon. The patient had always been previously healthy, and after a course of typical ulcer recovered and remained perfectly well. He also quoted Müller[3] who performed careful autopsies in cases of severe internal abdominal injuries, and who maintained that trauma was the cause of gastric and duodenal ulcer. There is another original report by Vanni[4] of a woman thirty-two years of age who developed the clinical symptoms of ulcer following a blow upon the epigastrium.

The earliest authentic clinical description is credited to Potain[5] in 1856. Thirteen years later his pupil Derouet was able to review 14 collected cases. In a Paris Thesis dated 1913, C. A. M. Petit[6] critically reviewed 73 cases, most of which seem to be capable of standing a strict scrutiny. It seems likely that on the cases contained in this literature the existence, and a clinical picture of traumatic ulcer may well be predicated.

Attempts have been made to reproduce this type of ulcer experimentally. Ritter[7] produced erosions in the dog's stomach by blows over the gastric region, particularly when the stomach was full of food. However, such experimental confirmation is of doubtful value.

A typical case which appears in the literature is that quoted by Kemp[8] in a woman of twenty-two who, without previous gastric symptoms, was thrown from a trolley car, striking the epigastric region. Pain and tenderness were present at this point and gastric symptoms developed. Six weeks later the patient had a second gastric hemorrhage of a severe type and developed the full syndrome of a gastric ulcer. After eight months of symptoms the patient was relieved and has remained well.

A more recent case is that of Chalier and Desjacques[9] who reported a duodenal-pyloric ulcer of traumatic origin. A man of thirty-seven was kicked in the epigastrium by a wounded horse. Immediately hematemesis ensued, which continued for twelve hours and was subsequently repeated on several days. The patient developed epigastric pains every two to four hours after eating, with frequent vomiting,

repeated gastric hemorrhages and melena. There was tenderness over the duodenal bulb by radiographic examination. Symptoms continued for five years with practically no relief.

Mattison[10] in a large series of peptic ulcers (1650 cases) found 25 instances where trauma may have or did play an etiologic role. This is a fairly large series of this type of case, though in only 9 instances was the injury directed to the epigastrium. He observes that the prognosis and outlook are good in most cases, particularly where no previous gastric complaints existed before the accident. The course of a traumatic ulcer is essentially that of the customary Cruveilhier ulcer, and like the latter, the longer its duration, the less likelihood there is of its cure.

Gunshot wounds of the stomach may not only produce perforation, but may produce extensive necrotic ulceration of the mucosa, as has been observed by Elliott and Henry.[11]

In the last few years there are reported some very striking examples of traumatic ulcer. Thus, in 1921, Griffith[12] related the case of a laborer who was struck by the handle of a spade in the epigastrium. He collapsed and immediately vomited gastric contents and blood. Symptoms of ulcer developed progressively. Six weeks later an exploratory laparotomy revealed a very small ulcer (¼ inch in diameter) on the lesser curvature near the pylorus. There was at this time no further operative interference, but within a year there was recurrence of hematemesis and of ulcer symptoms so severe that operation was again apparently indicated. The same ulcer was observed, larger in size and with more induration about it. A posterior gastroenterostomy resulted in an uneventful recovery. It is to be remarked however, that the previous history of this individual is not absolutely negative for gastric complaints since four years previous there is recalled in the anamnesis a short period of indigestion. In considering such a case, only those who have absolutely previously negative histories for indigestion or pain are eligible for consideration.

Stewart[13] reported the case of a man injured by coal falling upon his epigastrium. The diagnosis of ulcer was corroborated by roentgenographic studies. Within three months the ulcer had perforated.

In considering or reporting a case of traumatic ulcer of the stomach, it is important to keep in mind four postulates suggested by Liniger and Molineus.[14] They believe that claimants for compensation must satisfy these postulates before any claim could be considered valid: (1) Proof of the absence of gastric disease prior to the accident. (2) The trauma must be severe and localized to the epigastric region. (3) The immediate onset of symptoms. (4) The continuation of symptoms and signs that point to gastric or duodenal ulcer.

Bearing these postulates in mind a report is made of the following case, which was observed and seen through the courtesy of Dr. H. R. Livengood:

A. C. D., a widow, aged forty-four, had previously always been free of digestive disturbance. The appetite had been good, the bowels had been regular, and previous to the accident she had never had occasion to complain of any gastrointestinal symptoms. On February 12, 1930, while riding in a public conveyance, she was forcibly thrown against the sharp edge of the forward seat and on the opposite side of the aisle. The fall was a violent one, the accident being due to the front wheel of the bus striking a culvert. The sudden lurch of the vehicle precipitated her across the aisle. Immediately following the blow upon the epigastrium she fell to the floor of the bus. She was able, however, to proceed home. The next day she began to experience vague epigastric distress. Upon evacuation of the bowels she observed that the stools were black. Within another twenty-four hours she felt nauseous and vomited a large quantity of blood. Hematemesis and melena continued during her hospitalization of several weeks.

The physical examination within twenty-four hours after the accident showed a well-

nourished woman, pale and in shock. The heart sounds were normal, the rate somewhat increased; the examination of the lungs failed to reveal any unusual changes. A bruised and contused area was noted just below the ninth costal cartilage on the right side. On palpation of the abdomen considerable muscular rigidity was encountered in the epigastrium associated with marked tenderness. There was no enlargement of the liver or spleen and no other evidence of abdominal or intra-abdominal injury. There were bruises on the anterior aspect of both lower extremities. An examination of the blood three days after the injury showed that a secondary anemia was already present. Hemoglobin was 68 per cent, the red cell count was 3,250,000 and the differential white cell count was within normal limits. Both Kolmer and Kahn reactions were negative.

On March 3, 1930, or approximately two weeks after the accident, radiographic examination of the gastroenteric tract (Fig. 1) revealed a small niche on the lesser curvature of the first portion of the duodenum. This niche was well defined, was present in all plates, and was seen without difficulty during the fluoroscopic examination.

Fig. 1. Roentgenogram taken March 3, 1930. Note small niche of lesser curvature of first portion of duodenum (arrow). Two weeks after accident.

Fig. 2. Roentgenogram taken May 23, 1931. Note distortion of duodenal "cap" with niche on lesser curvature (arrow). One year after accident.

The patient remained in the hospital another week, the gastric hemorrhage being controlled by the usual means of rest, restriction of food intake, and morphine. Transfusion was at no time necessary.

For five weeks the patient was now free of symptoms; then indigestion recurred, characterized by epigastric pain several hours after meals, heartburn and relief by bicarbonate of soda. During this episode there was recurrence of a mild hematemesis with melena. The symptoms gradually abated but the woman was from this time on subject to periodic recurrences of digestive disturbances. At regular periodic times she suffered pain, heartburn, indigestion and vomiting, these periods of activity lasting three to four weeks and being spaced apart by several weeks. Two subsequent *x*-ray examinations, carried out in March and May 1931, confirmed the original observations made almost immediately after the acci-

dent. (Fig. 2.) In all the plates on these subsequent examinations one is able to discern a persistent duodenal ulceration, which in the later plates has all the appearances of a penetrating lesion. On the physical examination the patient had, and still has, exquisite tenderness in the epigastric region, slightly to the right of the midline.*

Apart from the history of the trauma in this case, there would be no hesitancy in considering it as one of duodenal ulcer. The case has every classical symptom of such a lesion. When the factor of trauma is introduced, the etiological relationship between the trauma and the ulcer gives rise to natural scientific curiosity. There was no previous history of indigestion. On repeated examinations and cross-examinations, the patient is completely unconscious of any digestive disturbance previous to her accident. The abrupt onset of the symptoms within twenty-four to forty-eight hours of the injury, the development within two weeks of the whole classical symptom-complex of ulcer plus the radiographic confirmation of the clinical supposition makes it impossible to escape the fact that the ulcer followed injury as effect to cause. No one except a person inclined to bend backwards in an attempt to be ultra-scientific and extraordinarily careful of his acceptances would question the diagnosis of duodenal ulcer, or would hesitate to acknowledge a likely relationship of such an ulcer to the abdominal trauma.

COMMENT

Robertson[15] has reviewed this question of abdominal trauma and has emphasized the fact that the stomach is exposed to injury in the epigastric area where it lies within the costal angle but below the protecting body of the liver. Posteriorly, however, the stomach lies directly anterior to the rugged vertebral column; any force applied to the epigastric region is liable to pin the stomach between the obtruding body and the rigid vertebrae. The bursting power of the stomach acts also as an etiological factor, since when full of food and subjected to a sudden violent compression, rupture of its mucosal surface may give rise to the beginning of a chronic ulcerative lesion. Frankel[16] considers that the stomach is more elastic crosswise than in its length, and that the greater curvature is more elastic than the lesser. The least elastic portion of the stomach is near the pylorus. Since objects naturally break at the point of least give and least elasticity, it is therefore logical to expect the mucosal tear, when exposed to a bursting force, to occur on the lesser curvature near the pylorus. In the opinion of Frankel[16] the same applies to the first portion of the duodenum. Robertson[15] further states that delayed rupture of the small intestine is by no means a surgical curiosity. Such a rupture may follow a contusion of the intestinal wall by several weeks or months. He offers in explanation that the area has become avascular and later breaks down, either with or without infection. This mechanism may explain the formation of a traumatic ulcer since experiments have fairly well determined that digestion of gastric mucous membrane will not take place in an area of normal vascularity.

In the case history just cited, the force of the injury was severe and was directly transmitted to the epigastrium. Whether the ulcer was caused by the direct compression of the stomach, or whether caused by hydraulic transmission is difficult to say. The time of the accident was about four hours after a light lunch, so that the rupture of an over-distended viscus is out of the question. Certainly the history follows the postulates of Liniger and Molineus:[14] (1) There was complete absence of gastric disease; (2) trauma was severe and was directed exactly to the epigastric area; (3) symptoms began before twenty-four hours and were severe and typical; (4) the character continued: symp-

* The New Jersey Supreme Court, No. 10, October term 1932, Agnes C. Denbleyker, Plaintiff-Respondent, vs. Public Service Coordinated Transport, Defendant-Appellant, decided that the judgment under review is affirmed with costs favoring the plaintiff described in the article. Reported in 11 N. J. Misc. 101; 164 Atl. 695.

toms and the chronicity of the course clearly indicated ulcer.

As regards these conditions, it is of interest to note the opinions of some of the active observers in this field. Einhorn[17] mentions a patient who received a painful blow in the mid-epigastric region and who complained of gastric distress, followed by three tarry stools. The patient was hospitalized and the condition diagnosed as acute peptic ulcer due to trauma. Friedenwald[18] found in a series of 200 of his ulcer patients that the causative factor was trauma in 2 per cent. In the opinion of Crohn[19] there seems little doubt that under exceptional conditions injuries can produce a gastric ulcer. He is now convinced that such injury may exceptionally or occasionally be a factor in the production of the familiar simple callous ulcer.

Medicolegal aspects of trauma and duodenal ulcer are of great importance. It would appear that the subject is still an open one, and meets with skepticism. The burden of proof is medical and sociological, on the shoulders of the one who postulates the hypothesis that ulcer and trauma are associated. From the medicolegal standpoint it requires not only the scientific conviction of the fact, but also the conviction of a lay jury or a lay court; beginning with the medical skepticism the difficulties of convincing the lay mind are evident. As such cases are not infrequent, with the increasing frequency of automobile accidents, the subject is likely to come up more often; it is therefore necessary to give due deliberation and thought to this issue of traumatic ulcer. Continental literature seems already to have accepted the likelihood, if not the existence of a traumatic gastric or duodenal ulceration. It behooves us in this country to give thought to this subject, so that we may be in a position to accept the fact, if such a condition does exist.

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PENETRATING WOUNDS OF THE ABDOMEN*

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IN civil practice, there are few hospitals which have the opportunity of treating a large number of penetrating wounds of the abdomen. During the past five years there have been admitted to the Emory Division of the Grady Hospital 180 such cases. The patients were all Negroes and a large variety of injuries was encountered. One hundred and thirteen were inflicted with the pistol. Stab wounds were second with 57 cases, which were usually due to knives, razors, or other cutting instruments. One rifle and 9 shotgun injuries are reviewed in this series.

The total mortality for the 180 cases was 46.6 per cent. Several factors were found to determine this mortality, namely, the method or type of injury, the time elapsing before treatment, the organs injured, and the treatment received. The mortality following the pistol wounds was 62.77 per cent, stab wounds 31.66 per cent, and shotgun 5 per cent.

It is now generally accepted that operation is the treatment of choice. There were, however, a small group of patients who presumably had abdominal injuries that were not operated upon, because of their extreme condition, or the time elapsing after the injury. The mortality for this group was 27.7 per cent as compared to the 26.6 per cent for those whose abdomens were explored. These results are misleading as there were some patients who probably did not have intra-abdominal lesions, or if visceral injury occurred it was of slight extent and healing took place without marked peritoneal infection.

Early differentiation between wounds of the abdominal wall and those penetrating the viscera was the first consideration. The final plan of treatment depended on the entrance or failure to enter into the abdominal cavity. It was not always easy to determine perforation of the abdominal cavity, as many showed none of the usual signs. Pain was by far the most constant symptom, with rigidity of the abdominal muscles the most constant finding. Nausea and vomiting were rarely encountered, and when seen, usually were indicative of upper abdominal injury, particularly of the stomach. When there was doubt as to entrance into the abdominal cavity, an early exploration was done.

The following case demonstrates the difficulty in making a diagnosis of intra-abdominal injury although there was extensive intestinal involvement.

CASE 1. H. W., No. 43569, a thirty-two year old male, was admitted to the hospital about thirty minutes after having been shot with a pistol. The bullet entered at the left external inguinal ring, going downward underneath the penis through the scrotum and passing into the adductor muscles of the right leg. There was a left inguinal hernia and the patient stated that at the time of the injury the sac was filled, but later the contents went back into the abdominal cavity. The only sign of an intra-abdominal lesion was tenderness on deep pressure in the lower left quadrant. An exploratory laparotomy was done because of the possibility of the bullet injuring the contents of the sac, although examination failed to reveal intra-abdominal involvement. At operation only a small quantity of blood was present but there were eleven perforations over an area of 16 inches in the lower ileum. In view of the numerous perforations and mesenteric involvement, resection and an end-to-end anastomosis were carried out. The patient had a stormy convalescence but left the hospital well.

In those patients exhibiting shock suitable measures must always be instituted

* From the Department of Surgery, Emory University.

to insure safer operative risks. However, there is a certain group showing increasing hemorrhage which makes an immediate operation imperative, when a delay of a few hours means almost certain death. Another factor in the reduction of mortality was the interpretation of individual primary shock and hemorrhage, which was by no means an easy task. The shortest time elapsing before operation in this series was one hour and the longest five days. The average period was three hours.

Case II. L. M. J., No. 44830, a male, aged eighteen, was admitted to the hospital after having been shot in the abdomen and left forearm. On admission there was definite evidence of hemorrhage, rapid pulse, profuse perspiration and thirst, marked rigidity of abdominal muscles, but no nausea or vomiting. The hemoglobin was 55 per cent, R.B.C. 2,640,000, W.B.C. 20,850. An immediate operation was performed due to the increasing hemorrhage. At operation there was much free blood in the abdominal cavity. The spleen was torn and bleeding freely. A splenectomy was done and the abdomen was closed without drainage.

This case exhibited clearly the value of not delaying operation where increasing hemorrhage was evident.

Case III. T. P., No. 32707, a young male, was admitted to the hospital immediately after being stabbed in the abdomen with a pocket knife. On admission there were several loops of small intestine on the abdominal wall and the patient was in marked shock. The operation was begun one and one-half hours after the injury, while there was still evidence of shock. At operation four perforations of the jejunum were found. After the perforations were closed the patient's condition rapidly became worse and death occurred before he left the operating room.

It was evident that operation was undertaken too soon in this case, before suitable treatment of the shock was instituted. The reason an early operation was undertaken was to replace the intestines as soon as possible. This case was an exact counterpart of Case II where a short delay would have resulted in death. In the absence of hemorrhage, the operation should be delayed until proper treatment of primary shock has been instituted.

Death was usually in direct proportion to the character and number of perforations present. Of the 180 cases, 123 had perforations of the viscera. Twenty-five had eventration of the intestines on the abdominal wall. Multiple perforations were more frequently found, usually occupying only a small area of the intestine. Simple closure of the perforation was the method most frequently followed but in multiple perforations resections of the damaged areas were done.

It is usually considered that injuries to the intestines are more fatal than those to the solid organs, but in this series the mortalities for injury to the liver, kidney, and spleen were 70.7 per cent, whereas the total mortality for the hollow viscera was 39.2 per cent. Lesions of the kidney were more serious with a percentage mortality of 87.5. The mortality for liver injuries was 83.3 per cent. Stomach wounds were first in the mortalities of the hollow viscera with 65.3 per cent, but one-third of these were associated with multiple perforations. Perforations of the small intestine were second with 37.7 per cent and of the large intestine and bladder 33.3 per cent each.

In recent years the matter of drainage has brought about much debate. Peculiar as it may seem the mortality for the cases drained was 43.13 per cent, whereas in those not drained it was 27.26 per cent. These results do not give a complete insight as to the value of drainage or closure without drainage, as the cases drained had the greatest number of perforations with contamination of the entire abdominal cavity. The important factor was to remove the source of contamination by careful closure of each perforation and removal of all gross contamination, such as fecal material, blood clots, and shot-gun wadding. The value of drainage is doubtful where the peritoneum has been contaminated with intestinal contents. In many instances

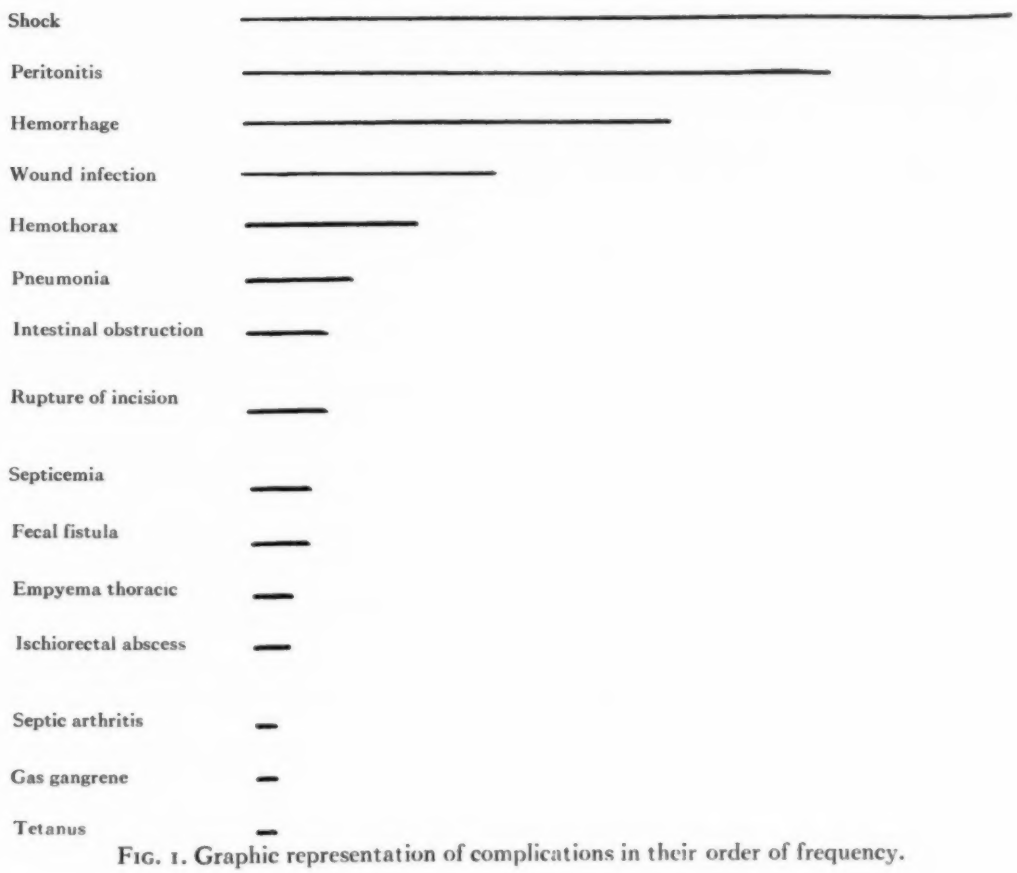

FIG. 1. Graphic representation of complications in their order of frequency.

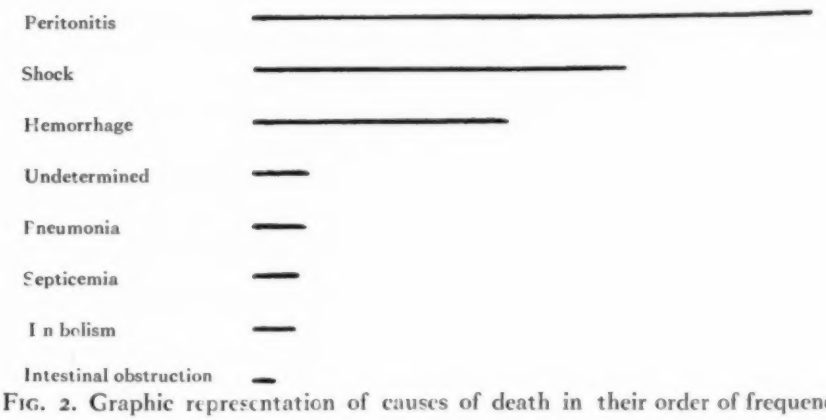

FIG. 2. Graphic representation of causes of death in their order of frequency.

drainage tubes do not aid in any manner in either draining or localizing an abscess that might develop. What usually happened in these cases was that the drains acted only as a foreign body and prevented drainage. The difficulty was in determining the most advantageous location of the drain as it was impossible to drain the entire abdominal cavity. The practice in this clinic has been to close all abdomens without drainage unless gross fecal contamination was present or if several hours had elapsed since injury. Where the abdominal cavity was closed tightly, a soft rubber drain was usually placed in the abdominal wall.

Stab wounds are of themselves a separate type of injury, where the mortality is considerably lower than the others. Many of these injuries are followed by an eventration of the intestines and an opportunity was afforded for general contamination. In the 57 stab wounds it was found that 26 showed perforations of the viscera with a mortality of 30.76 per cent. This revealed the ability of the peritoneum to overcome infection. Mechanical cleansing of the intestine with physiologic saline and replacement in the abdominal cavity after thorough search for perforations was found sufficient in those cases regardless of drainage. The use of chemical antiseptics to the intestines and peritoneum was unnecessary and was found to be dangerous, as those patients in whose cases mild antiseptics were used were in the hospital longer and had more distention and elevation of temperature.

In such a series of cases many unusual complications are seen (Fig. 1). Frequently multiple injuries, particularly to the pleural cavity, with the production of pneumothorax and hemothorax, increased the morbidity and mortality. The most common complication was primary shock; that is, those patients in which there was not sufficient evidence of hemorrhage to account for the prostration. General peritonitis and hemorrhage were next in order of occurrence, with 39 and 28 instances respectively. Infections of various organs were the most common late complications. Even as in the war injuries a case each of gas bacillus infection and tetanus were present. The patient with tetanus was given the usual 1500 units of tetanus antitoxin at the time of admission and the course was very mild. Septicemia was an infrequent complication, occurring in 2 instances with 2 deaths.

SUMMARY

1. One hundred and eighty cases of penetrating wounds of the abdomen, occurring in civil practice, with a mortality of 46.6 per cent, are reviewed.

2. Stab wounds show a much smaller percentage of mortality than do pistol wounds.

3. In stab wounds showing eventration with no perforations in 25 cases, there were no mortalities.

4. Mortality for the operated cases and a small group of non-operated ones shows practically the same percentage, which was probably an incorrect representation, since among the latter there were many instances in which no perforation was present.

CONCLUSIONS

The mortalities in these cases depend on the type of injury, the time elapsing before operation, and the structures involved. Early operation is an important factor after the patient has reacted from the primary shock. A differentiation of shock and hemorrhage is of value in determining the optimum time of operation. The closure of the perforations with removal of gross contamination is the procedure of choice. It is not always necessary to attempt to drain the abdomen for this is an impossibility. All cases should have an exploratory laparotomy when there is doubt as to whether there is visceral perforation.

Note. These cases are from the clinic of Dr. Daniel C. Elkin and are reported with his permission.

FRACTURES OF THE FEMUR

A PLEA FOR CONSERVATIVE TREATMENT*

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GENERAL REMARKS

IT is well known, that when a seed of a plant is kept in an envelope or in a drawer, it will remain a seed and inactive indefinitely. When, however, the same seed is placed in a position in which it can utilize moisture, air, and the energies of the sun, in the proper temperature, and a certain length of time is allowed, the seed commences to germinate. The time element depends upon the climatic conditions that affect the osmotic pressure and surface tension of the seed.

What is true of the living seed is also true of any other living substance. There are undoubtedly definite differences between some substances and others. Some need more moisture, others need more heat, depending whether one needs roots or surface growth. In the case of repair and particularly repair of bone, where similar physical forces play an important part in the formation of new bone, it is the duty of the traumatic surgeon to investigate and determine "the optimum physical agencies," which will enable him to get good union in the shortest possible time. That alone is not sufficient. One must not neglect the vitality and functions of the adjacent joints, muscles, nerves as well as the rest of the body.

A great deal of stress on the immobilization of fractures has been laid by many prominent surgeons. What is the aim in immobilization and in the utilization of the various appliances at the disposal of the surgeon? What are the advantages and disadvantages? Immobilization undoubtedly reduces pain and keeps the fractured fragments from irritation; in other words it keeps them in the position they are placed during reduction (or nearly so). On the other hand immobilization is conducive to impaired circulation, which has started with the injury to the blood vessels and nerves, aggravated by the edema of the tissues and further increased by the inactivity of the affected and surrounding parts. When splints or casts are used, there may also be impaired circulation due to pressure. In addition there is stiffness of the proximal joints of the injured part, which is proportionate to the period of immobilization. Many of the newer methods of extension and traction are also partially responsible for impaired circulation of the affected part, stiff joints and subsequent open operations. Even Roger Anderson's[1] ingenious new method, which utilizes the sound leg for traction, requires plaster casts not only on the injured limb, but also on the sound side. Higgs[2] uses plaster casts and anesthetics in all cases except the aged, in the latter he expects poor results. The majority of well-known surgeons speak of the safety of open operations and skeletal traction. The surgeon, who is called upon to see the work of others for the purpose of reporting to insurance companies or compensation boards, does not find these methods free from danger even in the hands of the most skilful surgeons. We are accustomed to report our good results: we are seldom anxious to teach by reporting poor results. It is true that the cases brought to the attention of the writer are, of necessity, those with poor results, but they are far too many to brush them away as mere accidents.

* Read before the Montreal Clinical Society, September 28, 1932.

For the past seven years the writer has used no anesthetics in any case of fracture of the shaft, upper and lower ends of the femur. By the utilization of a modified Böhler sling, no plaster casts were necessary, no skeletal traction, no open operation, no traction by means of weights, no special tables, no plaster room and the patients could be treated at home as well as at the hospital. The number of cases treated were well above one hundred[3] and although the fractures were usually in the aged, the results were uniformly good. There was not a single case of non-union in spite of early weight-bearing, neither were there any deaths due to pneumonia with the single exception of a woman seventy-nine years of age, admitted in a moribund condition with multiple ailments. She died on the second day.

Fig. 1. J. O'H. Multiple fractures of bones of leg, 3½ inches shortening.

GENERAL TECHNIQUE OF TREATMENT

The patient's thigh or hip is skiagrammed in bed. Stereoscopic films are taken whenever possible. The limb is then placed in a modified Böhler splint, the latter acts merely as a sling to the thigh and leg. The leg is anchored to one of the pulley wheels of the Böhler sling. By means of adhesive plaster the foot is supported to the perpendicular stand of the splint. The foot of the bed is raised. The weight of the body pulls on the proximal fragment. Thus the extension is brought about without weights. The semiflexed position of the knee on the sling helps in fixing the distal fragment. The thigh, hip and knee being completely exposed, baking and massage may be instituted even during the first week. The impaired circulation is thus attended to right from the start. At the end of two to three weeks, the injured part is skiagrammed and the position of the fragments noted; if satisfactory the sling is removed. At the end of six weeks the patient is allowed up on crutches, but no weight allowed on the injured limb. During that period patients often think

Fig. 2. Same patient with fracture of neck of femur. Shortening reduced to 2½ inches. Treated by sling method.

that the injured limb is longer than the sound one. The treatment causes hyperextension. When weight bearing is allowed after eight weeks, the soft callus in the process of hardening brings about normal length to the limb. An interesting case may be cited to illustrate this statement:

Case 1. J. O'H., aged sixty-five, received an injury to his left leg on November 13, 1929. A cast was applied. One of the fragments penetrated the skin and it was subsequently discovered that the simple fracture was converted into a compound one. The wound became infected and an osteomyelitis persisted for nearly two years. In September, 1931 he was referred to me for examination and report. At that time he had 3½ inches shortening, deformity, partial ankylosis of the knee and ankle and two discharging sinuses. Eventually the sinuses healed and he reported for the estimation of his permanent disability. This was on December 24, 1931, on which day he also slipped off a street car and fractured the neck of the femur on the same side. He was taken to his home and the case referred to me. The treatment already outlined was carried out at his home and he was allowed up after seven weeks. His adapted boot became too long for his limb, the shortening was reduced by one inch. Several prominent surgeons have examined him as well as members of the Workmen's Compensation Board and found his hip to be normal. (See Figs. 1 and 2.)

THE TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR

Approximation and alignment are accomplished by the method already outlined. The usual skin fixation by means of adhesive plaster is sufficient. No weights are employed. The Böhler "sling" somewhat modified (see Fig. 3) is all that is necessary. The foot of the bed is raised and the foot tied to one of the pulley wheels. The wheel is used because it allows a certain amount of play. After a period of three to four weeks a skiagram is taken. If apposition and alignment are good the sling is removed and a small adaptation splint is applied to the injured area and kept in place by means of a piece of adhesive plaster. The splint is usually made of two

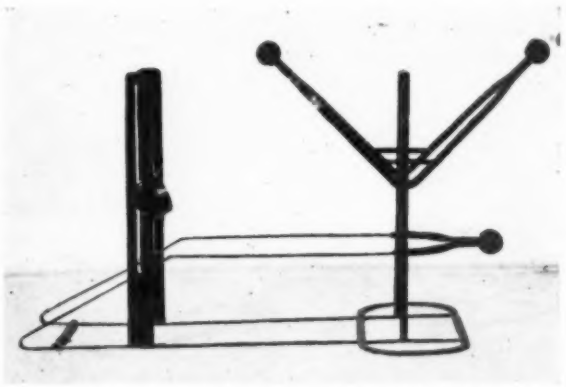

Fig. 3. Author's modification of Braun-Böhler splint.

tongue depressors. By means of this small splint the callus can be moulded or shifted in any direction almost within a day or two. The principle is the same as used by the orthodontist, except that the latter is dealing with formed bone, whereas the surgeon is dealing with soft callus. In eight weeks the patient is allowed up on crutches. The adaptation splint acts as a reminder to be careful. Weight bearing is allowed gradually and cautiously for fifteen to twenty minutes a day and is gradually increased. This method strengthens the muscles and the callus quickly becomes firm. Heat and massage to the knee and the exposed parts of the leg, ankle and thigh are supplied commencing two or three days after the injury.

The author saw many cases where surgeons preferred open operations; unfortunately the results were bad, so much so that amputation was imperative in at least 2 cases, one fifteen months after the original injury (see Fig. 4), the other eight months after the injury. The open operations were performed by exceptionally able surgeons, yet both cases were originally simple fractures. In the opinion of the writer the danger of infection is always great immediately after an injury. Later the operation becomes a difficult one. The introduction of a plate invariably delays

union (see Fig. 5). The application of a splint or cast at least prolongs the disability, often it delays union and is many times responsible for non-union (see Fig. 6). Often it creates a disability in one or more adjacent joints. The treatment of fractures of the neck of the femur does not differ from that of the shaft, except that no splints are necessary. The Böhler sling is used as outlined above. The inversion of the foot and leg is obtained by means of adhesive plaster and watched daily. The flexion of the thigh and knee help abduction of the thigh and inversion of the foot.

In the treatment of fractures of the lower end of the femur the improvised part of the Böhler sling plays an important part: an adaptable knee rest, adjusted to the proper height, the knee semi-flexed, the heel fixed to one of the pulley wheels and the foot dorsiflexed. Baking and massage are instituted on the third or fourth day. The apparatus is removed on the tenth day and the patient is allowed up at the sixth week with light weight-bearing during the seventh week.

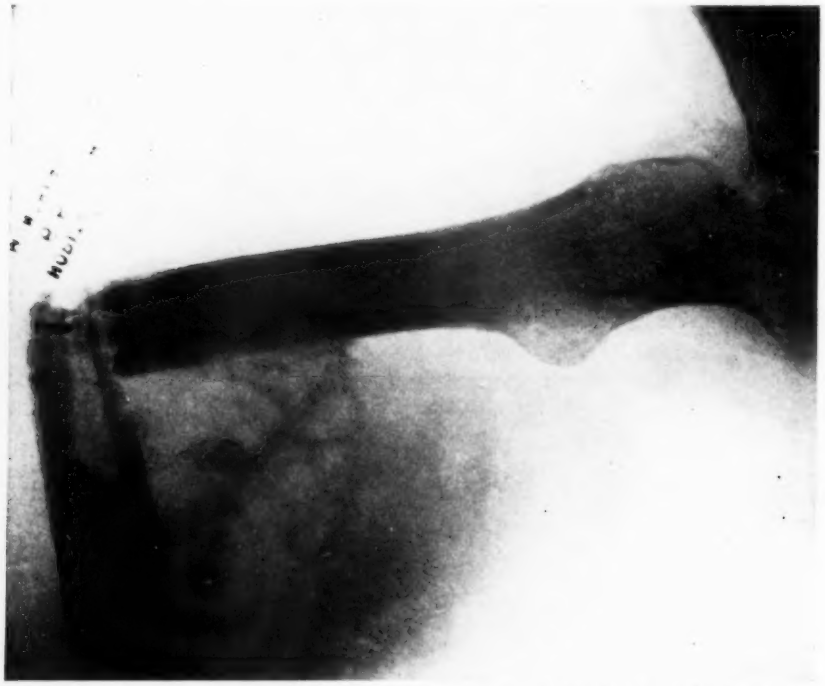

Fig. 4. P. D., aged twenty-nine. Fracture of left femur May 8, 1929. Various methods attempted at reduction. Plated, but plate broke; plate was removed, infection set in, abscess formation and subsequent amputation on January 10, 1930.

Author's Modification of the Braun-Böhler Splint (Fig. 3)

In 1719 J. L. Petit demonstrated a simple thigh and leg rest that enabled the knee and thigh to be semi-flexed. The splint was made of wood and therefore required padding. Its adjustibility was limited, but it had a posterior board to prevent foot drop. All the subsequent modifications were made in accordance with the principles laid down by Petit. In 1916 Braun constructed a simple splint, which consisted of a frame made of iron rods, similar to the frame work of this diagram. The frame is wrapped in bandages and the limb rests on the bandages. The posterior perpendicular frame was used to prevent foot-drop. Böhler subsequently modified the splint by adding pulleys for traction.

The modified part introduced by the author consists of a knee rest, which is adjustable. It can be raised or lowered,

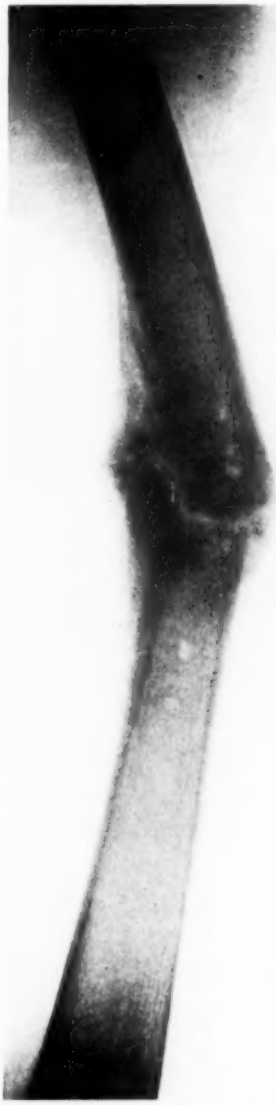

Fig. 5. W. P., aged fourteen. Femur plated October 12, 1928; plate removed three and a half months later. Discharged cured after four months. Patient was re-rayed for estimation of disability and plate showed solution of continuity of callus. By application of a tongue depressor to injured area (on recommendation of writer) and by application of heat, not only did callus become firm, but angular deformity was also corrected and boy was up and about in two weeks.

thereby increasing or decreasing the traction on the thigh or leg. It can be rotated forwards and backwards; it can also be raised on one side and lowered on the other; thus the position of the knee can be fixed.

What Sir Robert Jones' collar and cuff splint is to the elbow joint, the splint described (which the author often refers

Fig. 6. W. T., aged thirty-six. Fracture of neck of femur. Position good. Treated for four months with cast. After nine and one-half months surgeon discharged him fit for work. He was sent for examination and report twelve months after injury and this plate shows state of his hip. In addition he has limitation of movements of hip to extent of 20 per cent. There is also limitation of movements of knee joint.

to as a sling) is to the hip, thigh and knee, apart from its many other uses. The sling is also a Thomas splint minus the irritating and uncomfortable ring at the thigh. For the general comfort of the patient it replaces the Balkan frame.

Advantages of the Sling. The construction of the sling is simple and replaces plaster casts, weights, special tables, frac-

ture beds and skeletal traction.

The limb is not bandaged, thus it is exposed for biophysical stimulation right from the start.

Daily corrections can easily be made to suit conditions.

There is no manipulation of the limb. The patient is not moved for *x*-rays, because they can be taken with the sling in position. He is not moved for plaster casts.

The nursing is simple and does not interfere with the comfort of the patient.

An attempt on the part of the patient to use the limb, which is encouraged, improves the condition, strengthens the muscles, helps the circulation and does not disturb the fragments.

The patient can be treated at home.

Because of these advantages the deposition of callus is more rapid, the union of the fragments takes place early and the local and general disability are markedly minimized.

Fig. 7.

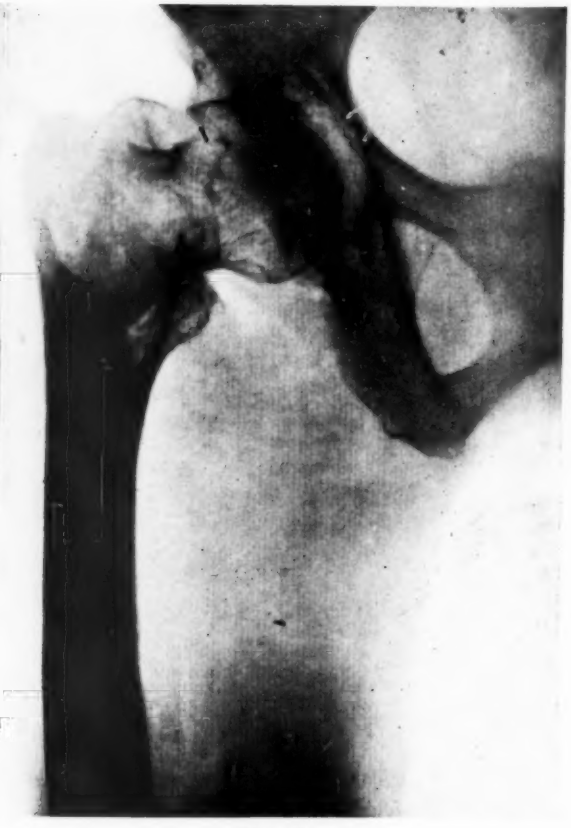

Fig. 8.

CASE HISTORIES

Case II. Mrs. N., aged ninety-three, a frail woman with a fracture of the neck of the left femur. She was taken to a hospital, where a plaster cast was applied. She refused to remain in the hospital. At home she was treated by the author. The cast was removed. She developed pneumonia. Eventually eight weeks after the injury she was up and about and walking with a cane. Six months later I was interested to see her condition. There was no shortening and she had no complaints. (See Fig. 7.)

Case III. Mrs. P., aged ninety, fracture of right hip and right wrist. After seven weeks the patient was up and about, with no shortening. While the wrist shows a slight deformity, she has full use of it; as far as the hip is concerned she has no disability. (See Fig. 8.)

Case IV. Mrs. A., aged fifty, fracture of the neck of the right femur. There was a 2 inch upward displacement, and a paralysis of the foot immediately after the injury. She was up and about in eight weeks. Sensation returned slowly. Paralysis persisted for six months. After ten weeks the sole disability was due to the foot condition. (See Fig. 9.)

Case V. Mrs. S. P., fracture of shaft of femur. This case presented special difficulties on account of a hunchback. She was up and about in ten weeks without any disability. The progress was checked up after eight months.

Case VI. Miss G., aged eighteen, fracture of the lower end of the femur extending into the knee joint. Movements of the knee were allowed after one week. The patient was allowed up after six weeks. There was no disability after ten weeks.

Case VII. Mrs. M. R., aged forty-five, comminuted fracture through the lower end of the femur with posterior displacement, fracture of the right clavicle. She was allowed up on a chair in thirty-two days, on crutches in forty-seven days and was fit to walk without a cane in sixty-six days. Two months later there was no evidence of any kind of disability.

SUMMARY

Many surgeons still report a high mortality rate in connection with fractures of the neck of the femur. Some years ago Lucas Championniere stated that more people die from immobilization than from injuries. The writer's personal experience with 36 cases of fracture of the neck of the femur, 55 cases of intertrochanteric fractures, 23 fractures of the shaft and 6 of the lower end of the femur, with only one death on the second day of admission to the hospital, even in the face of some criticism, 100 *per cent of live patients*, must endorse Championniere's statement as well as the treatment here outlined. Even the period of disability is markedly reduced. It must also be taken into consideration that 80 per cent of the patients ranged between sixty-five and ninety-three years of age, the remaining 20 per cent were between the ages of one and sixty-five. In a recent article by A. B. Gill[4] the mortality rate is estimated at 25 per cent and increases rapidly beyond the age of sixty. He also states that non-union may be expected in 20 to 25 per cent in cases treated by the Whitman method or by open operation. In comparing the mortality rates and percentage of non-union quoted by Higgs, Gill and many others, the simple treatment, which may appear to some radical, or at least unorthodox, but which is in reality very conservative, as here outlined, prevents death and gives firm union of the fragments in 100 per cent of the cases.

Fig. 9.

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A CLOSED METHOD OF REDUCTION OF

FRACTURE OF THE PATELLA

GATEWOOD, M.D.

CHICAGO, ILL.

THERE is no fracture which lends itself to open reduction more uniformly than complete fracture of the patella. Most recent texts scarcely mention closed methods of treatment. Frequently, however, either the general condition of the patient or some local complication makes operative reduction inadvisable or undesirable. In such a case, I have devised a method which I have not seen reported elsewhere, although the principles involved are well established.

FIG. 1. Comminuted fracture of right patella. Note separation of fragments.

FIG. 2. Fragments of patella approximated by use of rubber bands attached to hooks fastened in moleskin adhesive. A, shadow cast by cardboard incorporated in adhesive.

Dr. W. R. C., a heavy-set man of fifty-five, was thrown from his automobile near Hockerville, Oklahoma. He received a fracture-dislocation of his left humerus and a transverse comminuted fracture of his right patella. The dislocation was reduced by a local physician, a splint applied to the leg and the patient transported to the Presbyterian Hospital. On examination, there were no noteworthy physical defects other than the following:

The region of the left shoulder was swollen and discolored. Roentgenograms showed a chip off the margin of the glenoid, but complete reduction of the shoulder.

The right knee was greatly swollen and discolored. A large infected abrasion covered the prepatellar region. The patient could not extend the leg, but could flex it to a right angle. The *x*-ray films (Fig. 1) revealed a fracture of the patella with considerable separation of the fragments.

On account of the infection, it was necessary to resort to some closed method of treatment

which would permit of frequent change of dressings to the prepatellar region. This was accomplished in the following manner: A rectangular piece of moleskin adhesive, measuring about 6 by 8 inches, was prepared by fastening a one-inch strip of heavy cardboard to one of the longer margins and setting into it with a shoemaker's eyelet-set several shoe-hooks, about 5/8 inch apart. The adhesive was applied over the lower part of the thigh just above the infected area as shown in Figure 2. The leg, fully extended, was encased in a cast. A large rectangular window was then made in the patellar region. Similar hooks were attached to two other pieces of adhesive which were incorporated in the cast just below the knee. Finally strong rubber bands were strung between the upper and lower hooks. These served the double purpose of keeping the dressing in place and of maintaining sufficient tension to overcome contraction of the quadriceps extensor. They were tightened as often as necessary to keep up the tension. Although the method was primarily planned to prevent separation of the fragments until the infection had subsided, the result was so satisfactory (Fig. 3) that the method was continued for six weeks after which active and passive movements were instituted.

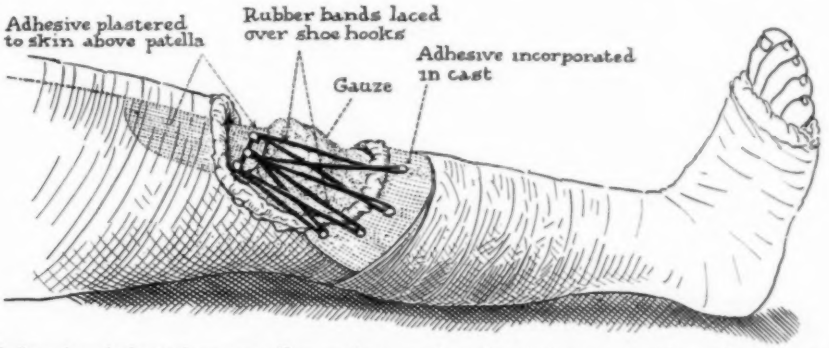

Fig. 3. Method of dressing infected prepatellar region and maintaining apposition of separated fragments of patella at same time.

The principle of Buck's extension was used many years ago in the treatment of fracture of the patella. A rope or cord was attached to a block which in turn was fastened to the thigh with adhesive, traction being maintained by carrying the cord over a pulley at the foot of the bed and attaching a weight to it. The adhesive tape-splint method, originally described by Agnew,[1] was used with good results in the case of King Edward VII of England who slipped, while descending a spiral staircase at Baron Rothschild's Manor and fractured his left patella. Sir William MacCormac,[2] after consultation with Lord Lister and others, applied a fenestrated cast and overlapped strips of adhesive carrying them obliquely from the supra-patellar region to the cast.

While the open method of reduction permits of accurate approximation and usually gives excellent results, infection almost invariably produces ankylosis and sometimes great disability. In spite of the fact that union by the closed method is probably always fibrous and in powerful individuals considerable separation of the fragments may occur, the functional result in this case has been so good that I believe its use is justified in selected cases.

SUMMARY

A modified traction closed method for the treatment of selected cases of fractured patella is described. It is a method which permits the patient to be partially ambulatory. It has given an excellent result in the case in which it was employed.

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A REVIEW OF THREE HUNDRED AND FORTY-SEVEN GALL-BLADDER OPERATIONS*

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DULUTH, MINN.

THIS study is one based upon an analysis of 347 gall-bladder operations. During the period of five years extending from 1925 through 1929 there were 670 operations on the gall bladder performed in this hospital. Forty or 5.9 per cent of the patients in this group died postoperatively. The operative procedures were performed by twenty-four different surgeons, although 87.9 per cent of the operations were done by eight men.

Form letters containing five questions were sent to these patients. These questions were as follows: (1) Do you consider yourself completely relieved? (2) Do you consider yourself only partially relieved? (3) Do you think your condition is unimproved? (4) Has it been necessary for you to have another operation for the same or similar trouble, and if so, what for? (5) Do you wish to say anything further in regard to your condition?

Three hundred and seven replies were received; 15 of the answers stated that the patients had died since leaving the hospital; while of these 15 only 4 letters stated as to whether any relief had been obtained. Therefore, there were 347 cases, including the 40 postoperative deaths, which form the basis of this study.

One hundred and eighty-six or 62.8 per cent of the patients reported complete relief; 87 or 29.4 per cent reported partial relief; while 23 or 7.8 per cent reported that no relief was obtained.

The extremes of ages in the cases living were fifteen to seventy-five years, with an average age of 40.9 years; while the ages in the cases that died postoperatively varied between eighteen and seventy-nine years, with an average of 51.2 years. So in this series there was a difference of 10.3 years in age between these two groups.

In the 347 cases, 295 or 85.1 per cent were women and 52 or 14.9 per cent were men. Of the 295 women, 215 or 87 per cent were multipara and 32 or 13 per cent were nullipara. In 48 cases the charts did not state as to whether the women had ever been pregnant.

In the 296 cases on which we received replies (Table 1) 2 or 0.7 per cent were under twenty years; 44 or 14.9 per cent were from twenty to thirty; 98 or 33.1 per cent were from thirty to forty years; 86 or 29.1 per cent were from forty to fifty; 49 or 16.5 per cent were from fifty to sixty; 12 or 4.1 per cent were from sixty to seventy years; while 3 or 1 per cent were between seventy and eighty years of age. In this series the years of highest incidence of gall-bladder disease were from thirty to forty years, while the twenty years between thirty and fifty contributed 62.2 per cent of the cases. Section A of Table 1 shows the age incidence as regards relief. Thus the highest incidence of partial relief was in the years between thirty and forty, when 35 or 35.8 per cent of the cases had partial relief, while the highest incidence in the no-relief group was between fifty and sixty, when 6 or 12.2 per cent had no relief. Section B shows that of the patients getting complete relief, the highest incidence was between forty and fifty years, when 59 or 31.7 per cent got complete relief; of the patients getting only partial relief the highest incidence was between thirty and forty years, when 35 or 40.3 per cent got only partial relief; while of the patients getting

* Presented before the Staff of St. Mary's Hospital, Duluth, Minn., June 2, 1932 and the Minnesota Surgical Society, June 17, 1932.

no relief the highest incidence was also between thirty and forty, when 7 or 30.5 per cent got no relief.

In the patients getting complete relief, practically the same as regards relief as is the incidence of gall-bladder disease in men and women.

Symptomatology (Table II) was studied

TABLE I

A. AGE INCIDENCE AS REGARDS RELIEF

	Under 20	Per Cent	20–30	Per Cent	30–40	Per Cent	40–50	Per Cent	50–60	Per Cent	60–70	Per Cent	70–80	Per Cent
Total	2	0.67	44	14.9	98	33.1	86	29.1	49	16.5	12	4.1	3	1.0
Complete relief	1	50.0	27	61.3	56	57.1	59	68.6	29	59.2	10	83.3	3	100.0
Partial relief	1	50.0	14	31.8	35	35.8	22	25.6	14	28.5	1	8.3	0	0.0
No relief	0	0.0	3	6.9	7	7.1	5	5.8	6	12.3	1	8.4	0	0.0

B. RELIEF AS REGARDS AGE INCIDENCE

Total	2	0.67	44	14.9	98	33.1	86	29.1	49	16.5	12	4.1	3	1.0
Complete relief	1	0.5	27	14.5	56	30.1	59	31.7	29	15.6	10	5.4	3	1.6
Partial relief	1	1.2	14	16.1	35	40.3	22	25.3	14	16.1	1	1.2	0	0.0
No relief	0	0.0	3	13.0	7	30.5	5	21.7	6	26.1	1	4.4	0	0.0

161 or 86.5 per cent were women while 25 or 13.5 per cent were men; in the partial relief group 80 or 91.9 per cent were women, while 7 or 8.1 per cent were men; under the headings of jaundice, dyspepsia (which included fullness, gas or bloating), definite gall-bladder colic, qualitative food distress, epigastric or right upper quadrant

TABLE II

A. COMPARISON OF SYMPTOMS AS REGARDS RELIEF

Symptoms	All Cases	Per Cent	Complete Relief	Per Cent	Partial Relief	Per Cent	No Relief	Per Cent
Jaundice	70	20.2	39	68.4	15	26.3	3	5.3
Dyspepsia	202	58.2	108	60.7	32	29.2	18	11.1
Gall-bladder colic	178	51.3	110	70.9	38	24.5	7	4.6
Qualitative food dist	137	39.8	56	48.3	49	42.2	11	9.5
Epig. or R.U.Q. pain	207	59.9	105	61.8	55	32.4	10	5.8
Nausea and vomiting	147	42.4	61	56.9	42	38.5	6	4.6
Nausea only	36	10.4	22	68.9	8	25.0	2	6.1

B. COMPARISON OF RELIEF AS REGARDS SYMPTOMS

Jaundice	70	20.2	39	20.9	15	17.2	3	13.0
Dyspepsia	202	58.2	108	58.1	52	59.8	18	78.3
Gall-bladder colic	178	51.3	110	59.2	38	43.7	7	30.5
Qualitative food dist	137	39.8	56	30.1	49	56.3	11	48.8
Epig. or R.U.Q. pain	207	59.9	105	56.4	55	63.2	10	43.5
Nausea and vomiting	147	42.4	61	32.8	42	48.3	6	26.1
Nausea only	36	10.4	22	11.8	8	9.2	2	9.7

while in the no-relief group 19 or 92.6 per cent were women and 4 or 17.3 per cent were men. This shows that the relative proportion between men and women is pain, nausea and vomiting, and nausea alone. Seventy or 20.2 per cent of the cases gave a history of jaundice; 202 or 58.2 per cent of dyspepsia; 178 or 51.3 per cent

of gall-bladder colic; 137 or 39.8 per cent of qualitative food distress; 207 or 59.9 per cent of epigastric or right upper quadrant pain; 147 or 42.4 per cent of nausea and vomiting, and 36 or 10.4 per cent of nausea alone.

Section A shows that 68.4 per cent of the cases with jaundice; 70.9 per cent of the cases with gall-bladder colic, and 48.3 per cent of the patients with qualitative food distress, got complete relief. Forty-two per cent of the patients with qualitative food distress got only partial relief, while 11.1 per cent of the patients with dyspepsia got no relief.

Section B shows that of the patients getting complete relief, 20.9 per cent had jaundice and 59.2 per cent had gall-bladder colic; in the patients getting partial relief, 17.2 per cent had jaundice and 43.7 per cent had gall-bladder colic, while in those getting no relief 13 per cent had jaundice and only 30.5 per cent had a history of colic. Also, in the patients getting no relief 78.3 per cent had dyspepsia, which is by far the major symptom in this group. This table shows a definite relationship between the incidence of jaundice and "gall-bladder" colic and the relief obtained.

Of the 347 cases 59 or 17 per cent had had some previous operation, as follows: 11 or 3.2 per cent had had cholecystostomies; 37 had had appendectomies, and 11 had had miscellaneous operations. Fifty-one or 14.7 per cent of the 347 cases had the following complaints and pathological conditions present in addition to gall-bladder symptoms, i.e. 2 diabetes, 8 hypertension, 2 pregnancy, 2 tuberculosis, 2 peptic ulcer, 3 adenoma of the thyroid, 2 lues, 1 hyperthyroidism, 4 hernias, 1 epilepsy, 3 heart disease, 2 migraine, and 19 miscellaneous conditions. The average duration of symptoms in all the cases was 4.4 years.

The preoperative diagnoses were as follows: 20 or 5.8 per cent acute cholecystitis; 214 or 84.2 per cent chronic cholecystitis; 78 or 22.5 per cent cholelithiasis; 1 or 0.3 per cent empyema, and 1 or 0.3 per cent hydrops. Thirty or 8.6 per cent of the cases had a preoperative diagnosis other than gall-bladder disease, i.e., 2 hernias, 1 ruptured ectopic pregnancy, 15 appendicitis, 1 carcinoma of stomach, 2 exploratory, 1 fibroid uterus, 1 ovarian tumor, 4 duodenal ulcer, 2 acute abdomen, and 1 tumor in right lower quadrant. Eighty-six or 24.8 per cent of the cases had a preoperative diagnosis of other pathology in addition to gall-bladder disease, i.e., 53 appendicitis, 12 pelvic and rectal conditions, 7 hernias, 6 duodenal ulcer, 3 common duct stones, and 5 miscellaneous.

As regards the *x*-ray findings by the Graham-Cole test as there had been no uniform reading of all the plates Dr. J. McNutt, roentgenologist of St. Mary's Hospital, very kindly reviewed all the plates that we could obtain so that there would be a uniform reading. However, many of the films had been lost or destroyed, so that we could report on only 70 cases. In giving the interpretation, the Mayo Classification was used, as follows: Normal functioning—stones plus or minus; pathological functioning—stones plus or minus; and poorly functioning gall bladder. A review of our cases showed that 1 or 1.4 per cent were "normal functioning" with no stones; 25 or 35.7 per cent were "pathological functioning" with stones; 43 or 61.5 per cent were "pathological functioning" with no stones, while 1 or 1.4 per cent was "poorly functioning." The *x*-ray diagnosis of "pathological functioning" with stones was proved to be correct at operation in 100 per cent of the cases. Where the *x*-ray diagnosis was pathological functioning—no stones, operation proved this to be correct in only 67.4 per cent of the cases as regards the finding of stones. The one patient with poorly functioning gall bladder was found to have a chronic cholecystitis at operation, while the patient with normal functioning gall bladder was found to have a chronic cholecystitis at operation. The *x*-ray diagnosis of pathological function was found to have a basis

of some gall-bladder pathology in all of the cases.

At operation the following pathology was found: 18 acute cholecystitis, 323 chronic cholecystitis, 23 empyema, and 6 hydrops. Along with these findings 229 or 65.9 per cent of the cases had additional findings: 159 with chronic appendicitis, 30 with hepatitis or chronic pancreatitis, 13 with hernias, 25 with pelvic or rectal pathology, 4 with duodenal ulcers, 1 with pregnancy, 1 with carcinoma of cecum, 1 with acute pancreatitis and fat necrosis, and 1 with lipoma on the back. This last case was interesting in that at operation this lipoma was found to be a dumbbell tumor extending between two vertebrae.

Table III

A. FINDINGS AT OPERATION AS REGARDS RELIEF

Findings	Complete Relief	Per Cent	Partial Relief	Per Cent	No Relief	Per Cent
Acute cholecystitis	12	92.3	0	0.0	1	7.7
Chronic cholecystitis	171	61.1	87	31.0	22	7.9
Cholelithiasis	120	73.6	39	23.9	4	2.5
Empyema	15	100.0	0	0.0	0	0.0
Hydrops	5	100.0	0	0.0	0	0.0
Other findings	70	61.2	60	31.4	14	7.4

B. RELIEF AS REGARDS FINDINGS AT OPERATION

Acute cholecystitis	12	6.5	0	0.0	1	4.1
Chronic cholecystitis	171	91.9	87	100.0	22	95.9
Cholelithiasis	120	64.5	39	44.9	4	17.4
Empyema	15	8.1	0	0.0	0	0.0
Hydrops	5	2.6	0	0.0	0	0.0
Other findings	117	62.9	60	68.9	14	60.9

A comparison of the findings at operation and the relief obtained (Table III) as in Section A, revealed the following: 92.3 per cent of the patients with acute cholecystitis obtained complete relief, 73.6 per cent of the patients with stones got complete relief, while 100 per cent of the patients with empyema and hydrops got complete relief. In comparing the relief with the findings as in Section B, we find that in the patients getting complete relief, 91.9 per cent had chronic cholecystitis, while in those getting partial relief, 100 per cent had chronic cholecystitis. Of those patients getting complete relief, 64.5 per cent had stones, in those getting partial relief 44.9 per cent had stones; and in those getting no relief 17.4 per cent had stones. Thus there is a definite relationship between the number of cases with cholelithiasis and the relief obtained.

A review of the operative procedures showed that cholecystectomy was done in 325 or 93.7 per cent of the cases and cholecystostomy in 22 or 6.3 per cent of the cases. Two hundred and forty-two or 69.7 per cent of the cases had other operations in addition to gall-bladder surgery, i.e., 195 appendectomies, 23 pelvic and rectal operations, 10 common duct drainage, 14 herniotomies, 9 gastrointestinal operations, and 1 removal of a fibrosarcoma from back.

Ten or 2.8 per cent of all the cases had common duct drainage. Of these, 5 patients died in the hospital postoperatively of the following causes: cholemia, pulmonary embolism, coronary disease, pneumonia, and acute yellow atrophy. One patient died 5 years after operation of carcinoma of the stomach, and 4 patients are living and reported complete relief.

Table IV

A. OPERATIVE PROCEDURES AS REGARDS RELIEF

Operation	Complete Relief	Per Cent	Partial Relief	Per Cent	No Relief	Per Cent
Cholecystectomy	177	62.3	84	29.2	23	8.5
Cholecystostomy	12	80.0	3	20.0	0	0.0
Appendectomies	123	69.4	43	24.3	11	6.3
Miscellaneous proced.	18	58.1	10	32.2	3	9.7

B. RELIEF AS REGARDS OPERATIVE PROCEDURE

Cholecystectomy	177	95.2	84	96.6	23	100.0
Cholecystostomy	12	6.5	3	3.4	0	0.0
Appendectomies	123	66.1	43	49.4	11	47.8
Miscellaneous proced.	18	9.7	10	11.5	3	13.0

A comparison of operative procedures and relief obtained (Table IV, Section A) revealed that of the cholecystectomies, 62.3 per cent were followed by complete relief, 29.2 per cent by partial relief and 8.5 per cent by no relief. Of the cholecystostomies 80 per cent effected complete relief and 20 per cent partial relief. Of the associated appendectomies 69.4 per cent were

followed by complete relief, 24.3 per cent by partial relief, and 6.3 per cent by no relief. Section B shows that of the patients getting complete relief 95.2 per cent had cholecystectomy, 6.5 per cent had cholecystostomy, 66.1 per cent had associated appendectomies, and 9.7 per cent had miscellaneous proredcues. Of the patients getting partial relief 96.6 per cent had cholecystectomies, 3.4 per cent had cholecystostomies, 49.4 per cent had appendectomies, and 11.5 per cent had miscellaneous procedures, and of the patients getting no relief 100 per cent had cholecystectomies, 47.8 per cent had associated appendectomies, and 13 per cent had miscellaneous procedures. The striking thing in this table seems to be that appendectomies were most prevalent in the patients getting complete relief.

TABLE V
PARTIAL AND NO RELIEF COMMENT

Complaints	Partial Relief	Per Cent	No Relief	Per Cent
Dyspepsia	8	9.2	12	52.2
P.O. hernias	8	9.2	2	8.7
Qual. food distress	11	12.7		
Gall-bladder colics	3	3.5	1	4.2
Ulcer operation	1	1.2		
Indefinite pains	16	18.4		
Indefinite and varied complaints	22	25.3	7	30.5

Of those obtaining only partial relief (Table v) the comment showed them to complain as follows: 8 or 9.2 per cent have dyspepsia, 8 or 9.2 per cent have postoperative hernias, 11 or 12.7 per cent have qualitative food distress, 3 or 3.5 per cent have gall-bladder colics, 1 or 1.2 per cent has had an ulcer operated upon, 16 or 18.4 per cent have indefinite pains, and 22 or 25.2 per cent have indefinite and varied complaints. In the no-relief group the comment details the following complaints: 12 or 52.2 per cent have dyspepsia, 2 or 8.7 per cent have postoperative hernias, 1 or 4.2 per cent has gall-bladder colics, and 7 or 30.5 per cent have indefinite and varied complaints.

The pathologist made the following diagnoses: 18 or 5.2 per cent acute cholecystitis; 310 or 89.5 per cent chronic cholecystitis; 202 or 58.2 per cent cholelithiasis; 5 or 1.5 per cent empyema; and 150 or 45.8 per cent appendices and other specimens.

TABLE VI

A. DRAINAGE OF WOUND

	No.	Per Cent	Ave. Stay	
Wounds drained	128	41.7	18.9	
Wounds not drained	179	58.3	16.4	15.3
All cases	...	....	17.5	16.9

B. POSTOPERATIVE HERNIAS

	Number	Per Cent
Drainage; No infection	7	41.2
No drainage; No infection	5	29.4
Drainage; Infection	2	11.8
No drainage; Infection	3	17.6
Total	17	

C. POSTOPERATIVE COMPLICATIONS

	Number	Per Cent	Per Cent of All Cases
Wound infection	15	27.3	4.9
Pulmonary	22	40.0	7.2
Phlebitis	5	9.9	1.7
Miscellaneous	13	22.8	4.6

In regard to wound drainage (Table VI) there were 128 or 41.2 per cent of cases drained and 179 or 58.3 per cent of the cases not drained. The cases drained had an average stay of 18.9 days while the non-drained cases had an average stay of 16.4 days. If the 211-day case is not counted, the average stay was 15.3 days. Thus the cases drained stayed 3.6 days longer in the hospital.

There were 17 postoperative hernias that the letters mentioned specifically, which was 5.8 per cent of all cases. Of these, 7 or 41.2 per cent were in cases with drainage and no infection: 5 or 29.4 per cent were in cases with no drainage and no infection; 2 or 11.8 per cent were in cases drained that developed infection, and 3 or 17.6 per cent were in cases not drained

that developed infection. Hence 70.6 per cent of the postoperative hernias occurred in cases with no infection, while 53 per cent of the hernias occurred in cases that were drained.

Fifty-five or 17.9 per cent of the cases had some major postoperative complication, as follows: wound infection comprised 27.3 per cent of all complications and occurred in 15 or 4.9 per cent of the cases (in these 15 cases 10 or 67 per cent had no drainage and 5 or 33 per cent had drainage); pulmonary complications comprised 40.0 per cent of complications and occurred in 22 or 7.2 per cent of the cases; phlebitis comprised 9.9 per cent of complications and occurred in 5 or 1.7 per cent of the cases. Miscellaneous complications comprised 22.8 of the complications and occurred in 13 or 4.6 per cent of the cases. Some of these were abortion and uterine sepsis, auricular fibrillation, psychosis, etc.

In the whole series there were 54 complications of which 28 or 51.9 per cent occurred in cases drained, while 26 or 48.1 per cent occurred in cases not drained.

In reviewing the charts we attempted to classify the cases as regards risk into 3 groups: good, fair or poor. We based our assumptions on the age, weight when given, blood pressure, blood picture, acuteness, etc., and accordingly we found 244 or 70.4 per cent to be good risks, 79 or 22.8 per cent fair risks, and 24 or 6.8 per cent poor risks.

As before stated, 40 or 5.9 per cent of 670 cases died. The average duration of life in these cases was 10.8 days postoperatively. Sixteen or 40 per cent of deaths occurred in the good risk group, 15 or 37.5 per cent in the fair risk group, and 9 or 22.5 per cent in the poor risk group. The anesthetics used were inhalation 34, of which there were 30 alone and 4 with local anesthesia; spinal 4, and local anesthesia 2. Twenty-eight or 70 per cent of the cases had drainage of the wound. In the cases drained, the patients lived 9.5 days while those not drained lived an average of 13.9 days. Pathologic reports on gall bladders in these cases were: acute catarrhal cholecystitis 3, chronic cholecystitis 31, cholelithiasis 29, and in addition 16 appendices. Nineteen or 47.5 per cent of the 40 cases had autopsies.

Table VII

Causes of Death in 500 Cases (Literature)			Causes of Death in St. Mary's Cases (40)	
	Number	Per Cent	Number	Per Cent
Operative shock	25	5.0	4	10.0
Operative hemorrhage	32	6.4	1	2.5
High temperature-rapid death	20	4.0		
Pulmonary embolism	33	6.6	5	12.5
Peritonitis (not bile)	77	15.4	2	5.0
Bile peritonitis	32	6.4		
Cholemia	42	8.4		
Hepatic Insufficiency	19	3.8	5	12.5
Cholangitis (liver abscess)	19	3.8		
Sepsis (pyemia)	16	3.2		
Pneumonia and pulm. deaths	53	10.6	10	25.0
Cardiac failure	34	6.8	2	5.0
Renal failure	24	4.8	1	2.5
Acute panc. and pulm. emb.	...	.....	1	2.5
Tetanus (wd. infection)	...	.....	1	2.5
Paralytic ileus and pneumonia	...	.....	1	2.5
Paralytic ileus and hep. insuff	...	.....	1	2.5
Acute panc. and coronary disease	....	.....	1	2.5
Miscellaneous	74	14.8	5	12.5
Total	500	100.0	40	100.0

Table VII is one in which 500 cases of postoperative death after gall-bladder operations are compared to the causes of death in this series of 40 cases. Operative shock accounts for 5 per cent of deaths in the literature and 10 per cent of deaths in this series; operative hemorrhage accounts for 6.4 per cent of deaths quoted from the literature as compared to 2.5 per cent in this series; pulmonary embolism accounts for 6.6 per cent as compared to 12.5 per cent in this series; and similarly there is 15.4 per cent peritonitis (non-bile) as compared to 5 per cent; 3.8 per cent of hepatic insufficiency as compared to 12.5

per cent; 10.6 per cent of pulmonary deaths and pneumonias as compared to 25 per cent; 6.8 per cent of heart failure as compared to 5 per cent; 4.8 per cent of renal failure as compared to 2.5 per cent, and in addition we report also as a cause of death acute pancreatitis and pulmonary embolism, tètanus (wound infection), paralytic ileus and pneumonia, paralytic ileus and hepatic insufficiency, and acute pancreatitis and coronary disease, each accounting for 2.5 per cent of deaths in this series. Thus it can be seen that pulmonary disease and pulmonary embolism account for 37.5 per cent of all our cases of death.

Table VIII is a tabulation of the cases reported on, relief obtained and deaths, in follow up studies by various men in the past eight years, and as such is self explanatory.

The averages for the whole group are as follows: a total of 7044 cases of which 5637 or 80.0 per cent were traced. There were 2551 or 74 per cent of cases considered well, 550 or 16.1 per cent cases improved, and 283 or 9.9 per cent of the cases with no relief. There were 296 or 6.4 per cent deaths. Thus as compared to the average, figures in this series show a 11.2 per cent lower average as regards complete relief, a 13.3 per cent higher average as regards partial relief, and a 2.1 per cent lower average as regards no relief. The death average in this series is 0.5 per cent lower than the total average.

TABLE VIII

SUMMARY OF CASES REPORTED BY FOLLOWING AUTHORS

Author	Cases	Traced	Per Cent	Well	Per Cent	Improved	Per Cent	Not Improved	Per Cent	Deaths	Per Cent
Cave	470	209	44.0	182	86.1	21	10.0	6	2.8	32	15.3
Clark	108	102	94.0	82	80.2	17	16.6	3	2.2	5	4.6
Cahell	634	461	72.7	269	58.4	93	20.2	99	21.5	35	5.5
Dahl-Iverson	146	146	100.0	126	86.3	11	7.0	19	12.0		
Danzig	113	113	100.0	90	80.0	8	7.1	8	7.1	5	4.3
Davis	156	144	92.0	100	69.4	38	26.4	6	4.2	4	2.7
DeConrey	64	64	100.0	51	80.0	6	9.3	3	4.5	4	6.2
Eliason and Ferguson	136	115	90.5	101	87.8	12	10.5	2	1.7	10	7.4
Fallon	800	800	100.0	...	....	...	....	..	....	37	4.6
Fowler	422	422	100.0	396	93.8	13	3.0	12	2.8		
Hitzrot and Cornell	400	384	96.0	203	52.8	107	28.0	30	7.5	37	9.6
Hueck	263	135	51.0	89	65.8	26	19.3	20	14.9	19	14.0
Iselin	100	100	100.0								
Johnson and Pearce	192	120	62.0	72	60.0	45	37.5	3	2.5	12	6.3
Judd and Parker	989	989	100.0	...	....	...	....	..	....	15	1.5
Marks	75	56	75.0	38	67.9	14	25.6	4	7.0		
Seulberger	304	217	72.0	180	82.1	6	2.0	20	9.0		
Verbrycke	302	302	100.0	...	....	...	....	..	....	21	6.9
White and Riddick	200	110	55.0	90	82.0	9	8.0	11	10.0		
Sanders	500	352	70.0	296	84.0	42	11.0	14	4.0	20	4.0
Goldish and Gillespie	670	296	46.9	186	62.8	87	29.4	23	7.8	40	5.9

CONCLUSIONS

1. The ratio of gall-bladder disease of men to women was 1 to 5.5 in this study.
2. The average duration of symptoms was 4.4 years.
3. The highest incidence of cases occurred between thirty and forty years.
4. The cases getting most relief were in the age group between forty and fifty.
5. The most relief occurred in cases having a history of jaundice or gall-bladder colic, while the least relief occurred in cases having "dyspepsia" as the major symptom.

6. An *x*-ray diagnosis of stones and of pathologically functioning gall bladder was very accurate.

7. Most of the patients with acute cholecystitis get complete relief. Seventy-three and six-tenths per cent of the cases with cholelithiasis got complete relief. In the complete relief group, stones had their highest incidence.

8. Only 62.3 per cent of cholecystectomies got complete relief.

9. Forty-one and seven tenths per cent of the cases were drained. Cases drained had an average stay of 3.6 days longer in the hospital than those not drained.

10. Seventeen and nine-tenths per cent of all cases had some major postoperative complication. Pulmonary complications and wound infection comprised 67.3 per cent of the complications.

11. Wound infection occurred more in cases not drained.

12. Postoperative hernias occurred in 5.9 per cent of the cases and occurred more often in cases not having wound infection.

13. Pulmonary complications comprised the most common cause of death.

14. The average age of patients that died postoperatively was 10.3 years more than those who lived.

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*Continued from p. 42.

PAPILLOMA OF THE GALL BLADDER*

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BENIGN tumors of the gall bladder were considered rare until MacCarty described cholecystitis catarrhalis papillomatosa in 1910; he was the first in this country to describe the condition. About the time of his report, cholecystectomy began to be recognized more and more as the best procedure in treating many cases of disease of the gall bladder. With this change in surgical procedure, more thorough examination of the interior of the gall bladder could be carried out, and papillomas began to be seen more frequently by the surgical pathologist. This increasing incidence of recognition of the condition is evident in the papers of Irwin and MacCarty, C. H. Mayo, Keene, Mölle, Abell, and MacCarty.

My study was of a group of 500 gall bladders, surgically removed at The Mayo Clinic between 1923 and 1929 which proved to contain one papilloma or more. These gall bladders were taken consecutively as they appeared in the course of all operations on the gall bladder. Special attention was given to the relationship of papilloma to malignancy, and to other diseases of the gall bladder. The corresponding clinical histories were reviewed.

The incidence by age of patients was found to be as follows: ten to twenty years, 0.4 per cent; twenty to thirty years, 6.2 per cent; thirty to forty years, 29 per cent; forty to fifty years, 30.8 per cent; fifty to sixty years, 27.6 per cent, and sixty to seventy years, 6 per cent. Of the patients from whom the gall bladders were derived, 68.4 per cent were females.

From these figures the high incidence of papillomas among patients of the comparatively early age group of thirty to forty years will be noted. Papillomas rarely occur before the third decade of life. Records of post-mortem examinations made at the clinic from 1922 to 1930 in cases in which death was from other causes than disease of the gall bladder disclose that only 3 cases of papilloma of the gall bladder were found among patients who were less than thirty years of age. These three patients were, respectively, twenty-two, twenty-four and twenty-six years of age. Mentzer, in his study of 633 consecutive postmortem examinations, found only one patient less than thirty years of age who had papillomatous cholecystitis.

All the sections studied microscopically gave evidence of inflammation, either in an acute, subacute, or chronic form, but by far the greatest number were examples of so-called chronic catarrhal cholecystitis, as is shown by infiltration of the submucosa by small round cells.

Etiologically I think two factors present themselves in the formation of papillomas: in one group infection plays the important part; in a second group, infection and metabolic disturbances work together. By far the larger number of cases will fall in the latter group.

In the cases of true inflammation, the gross appearance is that of papillary projections from the mucous membrane of the gall bladder; the color of the papilloma resembles that of the mucous membrane. The pedicle is of about the same size as the growth (Fig. 1). The growth, therefore, does not break off easily, but, as will appear, papillomas of the type next to be described do break off. Microscopically, the papillomas appear as projections with many branches, with very little stroma,

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and give evidence of containing but little fat on staining. Many small round cells may be seen in the pedicle, often as localized collections, and in the underlying mucous membrane (Fig. 2). This type usually occurs in the thick-walled, badly infected gall bladder, the mucous membrane of which has not been destroyed. Because of the character of the projections, it would appear that if any papillomas became malignant, this type which is caused by infection alone would be the group from which the malignancy would develop.

Fig. 1. Sessile papilloma, which is of same color as mucous membrane of gall bladder. Gall bladder was badly diseased.

In cases with both metabolic and inflammatory factors present, there are localized collections of cholesterol in villi, to such an extent that a papilloma is formed. The papillomas are yellowish, bulbous, easily detached, and often connected with the wall by a small pedicle (Fig. 3). The gall bladders are usually not badly infected, and not markedly thick walled. Microscopically the projections are heavily laden with large, foam-like cells which represent vacuolated fat, and when specially stained, are found to contain a large amount of fat (Fig. 4). Scattered throughout the substance of these projections are a few small round cells, and at times they form into definite collections depending on the amount of infection present.

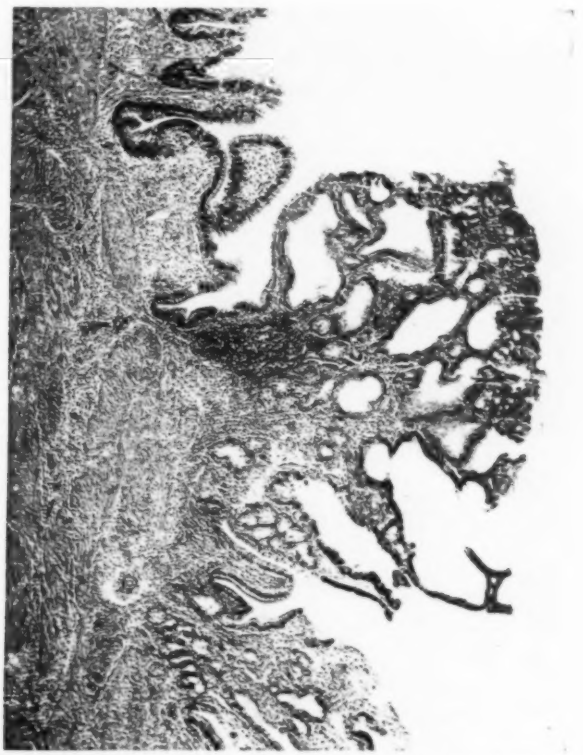

Fig. 2. Papilloma with rather broad pedicle and many branching projections. There is a collection of small round cells in pedicle.

This type is associated with the strawberry gall bladder described by MacCarty, since the projections have the same gross and microscopic appearance. The difference between a papillomatous and a strawberry gall bladder is a matter of degree; in the former, the cholesterol is collected into villi to such an extent that papillomas are formed. MacCarty stated that the appearance of the strawberry gall bladder is due to a lipoid substance within the swollen

connective tissue cells which lie just beneath the epithelium. When the villi become large and branched, they form

Fig. 3. Multiple papillomas attached by small pedicle, extremely friable.

papillomas. Histologically, such papillomas are identical with the villi of the strawberry gall bladder; the papillomas are merely larger and branched. If one were given a single villus of a strawberry gall bladder under a microscope, one could not state whether it was a villus of a strawberry gall bladder or a small papilloma. In some of the cases the cholesterol will be localized in one or more well-formed papillomas, without any other deposit of cholesterol appearing in the organ.

Nickel and Judd, in a bacteriologic and experimental study of 300 surgically resected gall bladders, concluded that most of the acute and subacute types contain pathogenic bacteria. The organisms are green-producing streptococci, gram-negative bacilli, and the staphylococcus in this order of frequency. Most of the cultures from chronically diseased gall bladders are sterile. Cultures from the strawberry gall

Fig. 4. Papilloma heavily laden with large vacuolated cells.

bladder also are usually sterile unless some complicating factor is present.

Often only one papilloma will be present, but larger numbers are not uncommon. In the series I studied, they were solitary in 41 per cent of cases, and multiple in 59 per cent (Fig. 3).

I found chronic catarrhal cholecystitis associated with papillomas in 255 cases (51 per cent), with strawberry gall bladder in 111 cases (22.2 per cent), and with stones in 76 cases (15.2 per cent). In 58 cases (11.6 per cent) chronic catarrhal cholecystitis was associated with strawberry gall bladder and with stones. There was, then, a total of 33.8 per cent of instances in which chronic catarrhal cholecystitis was associated with strawberry gall bladder, and in which the deposits of cholesterol were sufficient to recognize as yellowish projections; yet for all intents

and purposes the collections were localized in one or more papillomatous formations. In a high percentage of cases of chronic catarrhal cholecystitis and chronic cholecystitis with stones there is a type of papilloma like that usually seen in the strawberry type of gall bladder, but the collections are all localized to form papillomas. Of my entire group, 26.8 per cent were associated with stones.

Most of the papillomas are small. They usually vary in diameter from 1 to 5 mm. The largest papilloma noted in this series was 1.5 cm. in diameter.

Papillomas may occur in any part of the gall bladder, but they appear most frequently in the middle and cervical portions. Adenoma, a much rarer type of growth, usually occurs in the fundus. Only 9 cases of adenoma were found in my series of cases of papilloma, and all of the adenomas were in the fundus.

Duodenal ulcer was present in association with 20 of the papillomatous gall bladders (4 per cent). This figure is a little lower than that given by Eusterman, Mentzer and others for association of cholecystitis and duodenal lesions.

In reviewing the histories of the patients it was found that the usual symptoms were those either of cholecystitis, or of cholecystitis with stones.

The most important consideration is: Do papillomas of the gall bladder become malignant? This has been regarded as problematic by certain authors, although malignant degeneration has been reported by Ringel, Pels-Leusden, Siegert, and Hruška. In this series, no papilloma was found in which there was certain evidence of malignant change. In one papillomatous gall bladder there was also a carcinoma. The carcinoma may have started in a papilloma, but there was no way of proving that it had. In order conclusively to prove malignant change in a papilloma one portion of the papilloma would have to possess benign characteristics, whereas another part would have to possess malignant characteristics. In the case just mentioned the growth that was malignant was entirely malignant, whereas the associated papillomas, in other parts of the organ, gave no evidence of malignant change.

According to Judd and Baumgartner, in the experience of The Mayo Clinic the frequency of malignancy of the gall bladder has diminished from an average of about 5 per cent in earlier years to 0.5 per cent in later years. In 1910 there were 4 carcinomas in 165 cases in which cholecystectomy was done. In 1928 there were 5 carcinomas in 1094 cases. The lower frequency in the later years is evidently due to the gall bladder being removed earlier in the disease, before malignant change takes place. Stones are almost constantly associated with carcinoma of the gall bladder; to be exact, in 94 per cent of cases of carcinoma of the organ.

Since only one carcinoma was found in the 500 gall bladders which formed the basis of this study, the incidence of carcinoma in papillomatous gall bladders would seem to be a little lower than in diseased gall bladders as a whole. This may be more apparent than real; however, carcinoma does occur almost entirely in badly diseased gall bladders which contain stones, whereas papillomatous gall bladders represent a process resulting from less infection and with less injury to the mucosa. That the mucosa of papillomatous gall bladders is not injured is brought out by the work of Caylor and Bollman who found, in a study of the bilirubin content of bile from the gall bladder in cholecystic disease, that gall bladders which contained papillomas and the associated hypertrophic rugae concentrated bile more than any others in their series of 105 cases, which included all kinds of disease of the gall bladder. Papillomatous gall bladders appear to possess the greatest amount of absorbing surface because of the epithelial covering of the papilloma and the hypertrophic rugae. Caylor and Bollman concluded that the concentrating activity is absent in acute inflammatory disease of

the gall bladder, empyema, hydrops, and contracted gall bladders, whereas in cases of cholecystitis with associated papillomas and hypertrophic rugae, the concentration of bile is definitely increased. Between these two extremes wide variation in the content of bilirubin is found.

Kirklin also noted roentgenologically that the shadows of papillomatous gall bladders were of excellent density, and frequently were better than the average. This is in accord with the work of Caylor and Bollman. Kirklin was the first to diagnose papillomas roentgenologically, and this is usually the only method of diagnosing them before the organ is submitted for pathologic examination. Very rarely, papillomas may be seen shining through a thin-walled gall bladder when the abdomen is opened.

As infection progresses in a gall bladder, the walls become more and more thickened, the mucous membrane becomes ulcerated or destroyed, gallstones are formed, and it is reasonable to believe that the papillomas are destroyed along with the mucous membrane. Therefore, on opening thick-walled, badly diseased gall bladders, one does not expect to see papillomas as often as in gall bladders which give evidence of only moderate disease. In this series, 15.6 per cent of the gall bladders were the site of cholecystitis graded 1. Many cases of cholecystitis graded 1 will be missed surgically and consequently papillomas will be missed also. However, Judd and Wilkie both have expressed the belief that if a good history of disease of the gall bladder is given, and colic has occurred, even if the gall bladder does appear fairly normal at operation, it should be removed, because the percentage of cures will be high.

Papillomas also probably play a part in formation of stones, for each papilloma is a polypoid projection of mucous membrane and stroma, and is heavily laden with cholesterol esters. I have frequently seen them broken off and lying loose in the gall bladder and have also seen them break off on the slightest touch. Boyd, Stewart, and Mentzer expressed the belief that papillomas form nuclei for formation of stones, since they are polypi laden with cholesterol, and furnish ideal nuclei for precipitation of constituents of bile. Gosset, Bertrand, and Loewy also expressed the belief that they may break off and form nuclei for formation of stones, or that the cholesterol esters may be extruded following ulceration of the papillomas or the adjoining mucous membrane of a strawberry gall bladder, and in that way form nuclei. They found particles of small stones free in the bile in twenty of their 38 cases.

Although papillomas are fairly common now, I am sure that they may be frequently overlooked by the pathologist because of their small size, their friability, and their color; a small layer of bile may completely obscure them.

CONCLUSIONS

1. Pathologically, papillomas are of interest because of the place they occupy in relation to disease of the gall bladder.

2. From a clinical standpoint, treatment will have to depend on symptoms, for papillomas usually will not be recognized until the gall bladder is opened in the laboratory.

3. Malignancy was seen in only one of my group of 500 papillomatous gall bladders, and even in that instance, not etiologically associated with papilloma. It would not appear that malignancy would occur any more frequently in papillomas than in adjoining villi, since papillomas are only hyperplastic villi laden with cholesterol.

4. Papillomas occur, for the most part, in early disease of the gall bladder.

5. Papillomas may play a part in formation of gallstones, since when broken off from the mucous membrane they form a good nucleus for precipitation of constituents of bile.

[For References see p. 37.]

GALL-BLADDER DISEASE IN YOUNG CHILDREN*

HAROLD K. SHAWAN, M.D., AND EDGAR C. LONG, M.D.

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THE incidence of gall-bladder disease in young children has usually been considered very low. However, within a comparatively short period, 2 cases of cholecystitis or cholelithiasis in young children have been diagnosed at the Detroit Receiving Hospital. In view of the occurrence of 2 such cases in a rather restricted pediatric service, we turned with some interest to a review of the literature on this subject.

The first outstanding fact, which is almost immediately apparent, is the opposite stand that is taken by the standard works on pediatrics on the one hand and the current journals on the other. The authors in the pediatric books are almost unanimous in their opinion that gall-bladder disease is so rare in children as to not warrant serious consideration in differential diagnosis of abdominal pathology. Langley Porter states that pathological involvement of the gall bladder is practically unknown in children. "Conditions of this type are very rare in early life," write Griffith and Mitchell. "Occasionally a round worm penetrates into the bile duct and sets up an inflammation there. Acute cholangitis and cholecystitis are very infrequent conditions but may occur after typhoid fever or from sepsis. Cholecystitis of a more chronic nature is probably not an infrequent sequel of typhoid fever. Tuberculosis of the gall bladder is sometimes seen. Very exceptionally gallstones are discovered."

Upon turning to the journals, however, one finds a notably different attitude on the subject. Kellogg, who bases his article upon a review of the literature of cholecystitis and cholelithiasis in childhood, starting with a report of a case by Gibson in 1722, finds that 64 cases have been collected in that period of two hundred years. He concludes that the observations gathered were sufficiently numerous to indicate the importance of this affection which has barely been touched upon by the classical authors of diseases of childhood, and to lead to the conclusion that it is not so rare as has generally been believed.

Finding 4 verified cases of gall-bladder disease in his own practice over a period of three and a half years, Potter found this fact so much at variance with accepted ideas on the subject that he investigated the literature and found that the incidence of gall-bladder disease is much more prevalent in young subjects than is commonly believed. He was able to collect 200 cases of gall-bladder disease in children under fifteen years of age.

Snyder states that gall-bladder disease in children has always been considered a rarity, but in view of the fact that he has found 3 cases of gall-bladder disease in his own practice he reviewed the literature and noticed that the lesion is far less rare than one would expect.

Paterson and Wyllie report the occurrence of abdominal pain of increasing frequency and severity in a Jewish girl of nine years of age. A diagnosis of appendicitis was made and an appendectomy done. The appendix was found, microscopically, to be in a state of mild inflammation. The operation did not relieve the symptoms, however, and a secondary laparotomy showed a thickened gall bladder containing five or six stones.

Carey presents a case of cholelithiasis in a nine year old girl similar to Paterson and Wyllie's case. He concludes that, while

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this condition is very rare, every child, irrespective of age, who has an abdominal operation, is entitled to an examination of

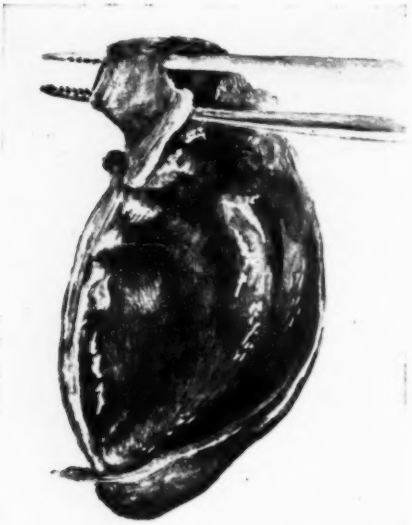

Fig. 1. Acutely inflamed gall bladder removed from child of three. Forceps pass through cystic duct which had been blocked.

the gall bladder.

Dunbar Walker observed icterus in a one month old child; two months later the child had a severe abdominal pain which was followed by the appearance of three ovoid gallstones in the stool.

Stoltzner notes a case of a seven and a half year old child with icterus and liver tumor. After a typical abdominal pain this patient passed twenty small stones which, upon chemical analysis, were found to be pure cholesterin.

In her work on cholelithiasis in children, Edith Kruger described the case of an eleven year old child who was admitted to the hospital with a diagnosis of appendicitis but was eventually operated upon for gallstones. A large gallstone was found blocking the cystic duct and seven larger stones were in the gall bladder proper. Some of these stones were pure cholesterin while the others were of a mixed variety.

Muller reports a case of a nursling child who died from bronchopneumonia. Upon autopsy the gall bladder was found to be full of concretions. There had been no evident gall-bladder symptoms.

INCIDENCE OF GALL-BLADDER DISEASE

Sixty-four cases are grouped by Kellogg under three headings; cholelithiasis of early infancy; cholelithiasis of later childhood and cholecystitis without gallstones. In his series of cases he found 25 in males, 18 in females and 21 whose sex was not stated.

Potter, in his series of 226 cases, found 62 males, 74 females and 90 whose sex was not stated.

From these two contradictory sets of figures it is apparent that no definite conclusions can be drawn, although, as Potter's series is longer, more importance can be attached to them, and the statement made that: "even as in adults, the incidence of gall bladder disease is more common in female children than in male children."

As to age incidence, Potter summarizes his cases as follows:

Fetus	2
Newborn	12
Very young	9
Infant	19
Child	4
Less than one year	14
One to five years	26
Five to ten years	55
Ten to fifteen years	85
	226

Kellogg found:

Fetus	1
Newborn	7
Very young	1
Infant	3
Child	1
Less than one year	6
One to five years	7
Five to ten years	13
Ten to fifteen years	25
	64

ETIOLOGY

Still found a greater tendency to formation of gallstones during early infancy than in later childhood and felt that in most of the newborn cases the calculi had been formed during intrauterine life. In performing a considerable number of autopsies

on infants he noted (1) that the bile in the gall bladder is often very viscid in early childhood, (2) that calculus formation in the gall bladder is often associated with congenital narrowing of the common duct and (3) that stagnation may exist as a result of the muscular inactivity of the intra-uterine period.

Other factors have been considered by various writers regarding the etiology of gall-bladder disease in older children, notably Farr, who suggests bacteriemia secondary to appendicitis as an etiological factor. The work of Eisendrath and Wharton, as well as Snyder, supports this contention because in their cases appendicitis was found concomitant with the gall-bladder involvement.

Typhoid fever plays an important role in the etiology of gall-bladder disease according to the work of Reid and Montgomery, was collected 18 cases of typhoid fever in children under the age of fifteen who either died from, or were operated upon for, complications arising in the gall bladder. Bittner had three cases of acute cholecystitis with perforation and peritonitis. Lowenberg had a similar case. In two of these, typhoid bacilli were recovered from the gall-bladder pus. Both were operated upon and both recovered. In one of these cases, in which the swollen gall bladder could be palpated, there was pain at its site, tenderness on pressure and some guarding of the muscles overlying it. Although vomiting was a feature of the case there was no jaundice and it was several days after the appearance of these symptoms before perforation took place.

REPORT OF TWO CASES OF GALL-BLADDER DISEASE IN YOUNG CHILDREN

Case 1. The first case is that of a negro male child, three years of age, who was admitted to the Detroit Receiving Hospital with a chief complaint of pain in the upper abdomen, followed by nausea, vomiting and general malaise. The history of his present illness (as furnished by the parents of the child) was, that a week before admission to the hospital he had fallen down a flight of stairs. Since that time he had complained of a great deal of pain in his upper abdomen, his appetite was poor and he had frequent attacks of vomiting. Previous

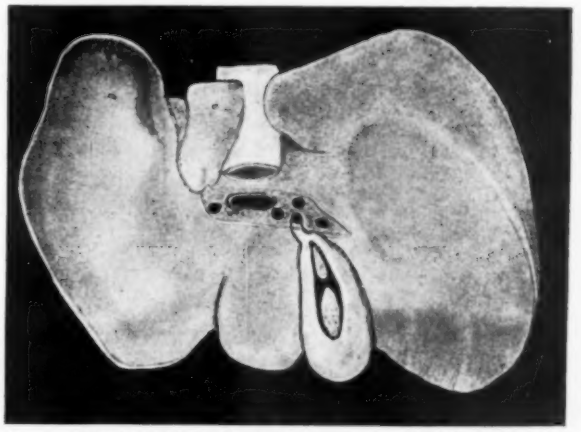

Fig. 2. Cholelithiasis in infant one week old. Posterior aspect of gall bladder and liver is shown.

to the onset of his present illness he had always been healthy, as yet not having had any of the diseases of childhood.

Physical examination revealed a well-nourished, colored male child, lying in bed, apparently not acutely ill. Pulse, temperature and respirations were normal at time of admission to ward. In the upper right abdominal quadrant there was a sharply protuberant, quite movable, globular mass, just lateral to the umbilicus and tender to palpation. Otherwise the physical examination was entirely negative.

Roentgenographic study of the abdomen showed there was an oval shadow about the size of a quarter and of soft tissue density in the right upper quadrant, adjacent to the edge of the liver and overlying the shadow of the gas distended colon. The upper border of this shadow was scalloped and suggested either a cauliflower growth or gallstones. The *x*-ray studies were inconclusive.

Two days after admission the patient was operated upon and found to have a very much enlarged gall bladder. It was about 7 cm. long and the tip extended nearly 3 cm. beyond the edge of the liver. The gall bladder and appendix were removed. On opening the gall bladder the cystic duct was found to be closed by a very large, thick, tenacious block of mucous detritus. No bile was present in the gall bladder. The wall was markedly thickened and the mucosa was of the strawberry variety. The appendix was much longer than normal and the serosal vessels were somewhat injected.

A pathological study of the material obtained at operation showed that the gall-bladder wall was thickened and fibrotic. Extensive inflammation was present. The inflammatory infiltration and edema, together with the mucosal hemorrhage, largely obliterated the normal histology. There was frank ulceration of the mucosa. There was mild hyperplasia of the lymphoid ring of the appendix. A diagnosis of severe chronic ulcerative cholecystitis was made.

The patient's immediate postoperative course was rather stormy but he gradually improved and was discharged from the hospital in an improved condition one month following the operation.

Case II. The second case was that of a one week old, white male infant, admitted to the hospital because of excessive bleeding from the umbilicus and jaundice. At the time of delivery he was a full term, apparently normal baby, the result of a spontaneous delivery. On the second day postpartum he became jaundiced. The jaundice became progressively worse until twenty-four hours previous to admission when the patient's father thought it had lessened a little. Thirty-six hours previous to admission patient began bleeding from the umbilicus, the cord having sloughed off. The bleeding was finally controlled by sutures although some oozing persisted. His condition on admission was poor and despite supportive treatment he rapidly became worse and expired seven hours later. Blood cytology: Hb 3.8 gm., R.B.C. 1,440,000.

At necropsy the subject was found to be a fairly well-developed, white male infant, apparently one week old, measuring 50 cm. in length. The skin, mucous membranes and sclerae were intensely icteric. There were no abnormal findings in the cranial cavity or thoracic cavity. The gall bladder was small and contained two calculi. These calculi were ovoid in shape and measured 1 cm. in greatest diameter. One of the calculi acted as a ball valve. The appendix was 7 cm. in length but showed no evidence of inflammation. There were no further abnormal findings. A final diagnosis of cholelithiasis, associated with severe icterus, was made.

CONCLUSIONS

From this review of the facts in connection with the occurrence of gall-bladder disease in children, we find that, although it is classed as a rarity by many writers, at least 112 cases are reported in the same age group as the cases we report. Therefore, despite its apparent rarity, gall-bladder disease should be considered in the diagnosis of intra-abdominal pathology in children. A difficulty in the path of diagnosing gall-bladder disease in children, a difficulty found in the other branches of pediatrics, however, is the dependence upon objective rather than subjective findings. A definite history and a resume of subjective findings from the patient himself would make the diagnosis of gall-bladder pathology as much a routine matter in children as in adults.

The interrelation of cholecystitis and appendicitis was stressed by several writers. In one of the cases we report, this was noticed. Although the microscopic examination of the appendix showed no apparent pathology, when the abdomen was opened it revealed a long appendix which grossly appeared to have been the site of previous inflammation.

Gall-bladder infection in children should not be neglected. Often, as the local symptoms are unobtrusive, the condition is overlooked.

Elimination of foci of infection would tend to decrease the susceptibility to gall-bladder disease if the work of Rosenow is accepted. He claims that cholecystitis in children probably occurs when streptococci, having an affinity for the gall bladder, enter the blood stream.

Cases of cholecystitis and cholelithiasis in children should be systematically recorded, for, there have been, no doubt, numerous cases which have not found their way into the literature on the subject.

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[For Remainder of References see p. 119.]

A COMPARATIVE STUDY OF THE

LEUCOCYTE COUNT AND HISTOPATHOLOGY IN ACUTE APPENDICITIS

VALUE OF THE SCHILLING COUNT IN ESTABLISHING THE DIAGNOSIS

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CHAMPAIGN, ILL.

RECENT observations of the blood count in appendicitis have indicated, on the part of the surgeon, a growing skepticism as to its helpfulness in diagnosis—on the part of the clinical pathologist, a persistent optimism. It would seem in all fairness to the situation that the surgeon's diagnosis should be considered along with the pathologist's in compiling data on this subject.

For example, Portis[1] reports 100 cases of fulminating appendicitis in children, where 20 per cent of the leucocyte counts ranged from 4800 to 7200. Ginn,[2] in his series of 70 acute cases, also finds 20 per cent of the leucocyte counts were under 10,000; 17 per cent showed polymorphonuclear neutrophiles under 70 per cent and in 6 instances this occurred with the low leucocyte count. He considers leucocytosis inconstant and unreliable. Neither paper mentions confirmation of the diagnosis by tissue sections. Koritschoner,[3] however, utilizing the histologic data for 170 patients, reports only 7 per cent of the white cell counts being under 10,000 in the acute cases. In the subacute and chronic cases he finds 20 per cent with counts above 10,000. He considers leucocytosis an aid in diagnosis of appendicitis, but not a criterion for operation. Miller[4] urges routine differential counts with constant use of Gibson's chart (see Fig. 1) to show the relation of leucocytes to neutrophiles, since an ascending line on the chart (low white cell count with increased neutrophiles) indicates lack of resistance to a severe infection. He observes 75–80 per cent neutrophiles in mild septic conditions, more than 85 per cent neutrophiles with pus formation, and more than 90 per cent in grave conditions such as a diffuse peritonitis. Neal and Robnett,[5] comparing preoperative blood counts with tissue sections for 227 patients, confidently state that a rising line of several units on Gibson's chart calls for immediate surgical intervention, while no increase, or even a decrease of the proportion of neutrophiles to leucocytes, with rare exception, shows absence of a severe form of inflammation. And Simon[6] says abdominal pain associated with lymphocytosis is very rarely appendicitis; but neutrophilia with aneosinophilia, in differentiating acute appendicitis is a more valuable factor than pulse or temperature, being present as early as there are clinical symptoms of inflammation and continuing until they subside.

Because of such divergent opinions in the literature, and because local surgeons occasionally have complained of the unreliability of the routine preoperative blood count as a factor in diagnosis, the following studies have been undertaken in this laboratory, to determine:

1. The number of cases diagnosed acute appendicitis that are confirmed by tissue sections;

2. The incidence and degree of leucocytosis;

3. The incidence and degree of neutrophilia and its relation to leucocytosis;

4. Whether the Schilling count, or any other procedure could supplement the routine white cell and differential count to give preoperative information that would more closely parallel the tissue

diagnosis, particularly where the leucocyte count is not greatly increased.

Histologic sections were read by Dr.

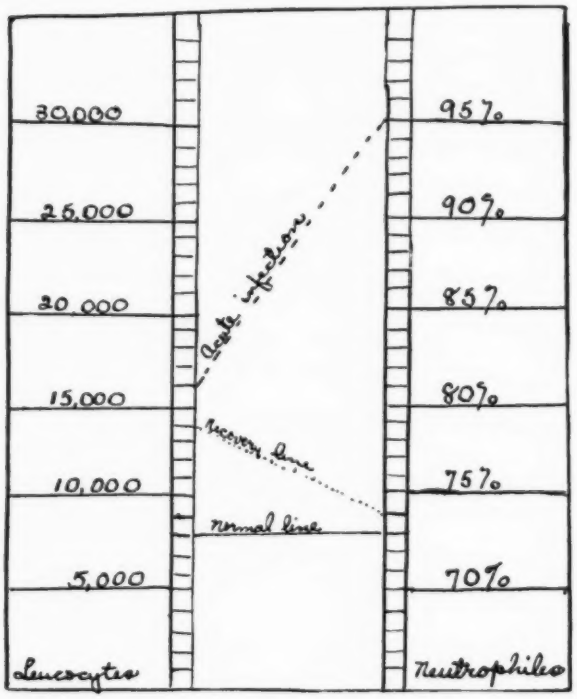

Fig. 1.

B. G. R. Williams, tissue pathologist at Burnham City Hospital. For simplicity all cases of subacute or chronic or recurrent appendicitis have been grouped together as non-acute. Because of the common use, by surgeons, of the term gangrenous appendix, all histologic manifestations of necrosis are listed as gangrene. Perforation is admitted only when extending from the lumen of the appendix through the outer coats, as determined from gross and microscopic sections. It is conceded that without serial sections some perforations may have been missed. Peritonitis includes both local peritonitis as observed in sections and those suppurative cases of general peritonitis originating in the inflamed appendix. Simply acute appendicitis, without necrosis, perforation, or peritonitis, includes acute diffuse suppurative, ulcerative, catarrhal, or obstructive appendicitis.

1. *Control Series.* White Cell Count with Ordinary Differential.

In a first series of 104 consecutive cases of appendicitis, 71 operations were performed with a diagnosis of acute appendicitis, 33 with subacute, recurrent, or chronic appendicitis. When sectioned, 8 of the 71 were non-acute and 4 showed no pathology. Ten of these 12 had increased white cell and differential count, 5 of which showed pathology elsewhere. Two showing no micropathology in the appendix had less than 10,000 white cells and less than 75 per cent neutrophiles. (See Table 1.)

Of the 59 histologically acute cases 41 showed leucocytosis above 15,000; 8 of these were from 30,000 to 39,000, none of which showed ascending line on Gibson's chart. Three were under 10,000 with less than 75 per cent neutrophiles. One of these, with gangrene, showed 72 per cent neutrophiles and 8400 white cells making a descending line on the Gibson chart. One with peritonitis showed 53 per cent neutrophiles, lymphocytosis and 7600 white cells, indicating wide divergence downward on Gibson's chart. Distal acute ulceration was present in the third case with 6600 white cells and 64 per cent neutrophiles. No children were included in these 3 cases. There were 6 cases with gangrene in the group showing 10,000–15,000 leucocytes, each showing the ascending line on Gibson's chart, as compared with the cases of simply acute appendicitis in this group where only one showed an ascending line. Thus this factor was more constant with the severe cases of 10,000–20,000 white cells than with those of either very high or normal white cell counts.

This study revealed that 17 per cent of the clinically acute cases were nonacute histologically, of which 5 per cent showed no pathology of the appendix. Half of this 17 per cent showed leucocytosis with neutrophilia. Leucocytosis above 10,000 occurred in 95 per cent of the cases of proved acute appendicitis, in 48 per cent of the non-acute. Leucocytosis above 15,000 occurred in 70 per cent of the acute cases, in 52 per cent of the non-acute. An ascending line on Gibson's chart was observed in 41 per cent of the acute cases

and also in 30 per cent of the non-acute. Only 5 per cent of the acute cases had less than 70 per cent neutrophiles. (See Table III.)

2. *White Count with Schilling Differential.*

In continuing the comparisons through 173 subsequent cases of appendicitis, Schilling's method for differential blood counts was followed in order to determine to what extent the immature neutrophils were increased, particularly when leucocytosis was slight or absent.

Schilling's method, briefly, amounts to subdividing the polymorphonuclear neutrophilic granulocytes into four groups according to nuclear form: myelocytes, simple round nucleus; juveniles, slightly indented nucleus; stab forms with band-like nucleus; and segmented, mature cells whose nuclear lobes are connected by no more than fine threads of nuclear material. The myelocyte and the juvenile are bone marrow cells, not normally found in peripheral blood, and therefore are considered younger cells. Schilling[7] gives as a normal average, 4 stab forms out of an average normal neutrophilic percentage of 67. By arranging such a differential count from left to right across a page, having myelocytes at extreme left, then juveniles, stabs and segment forms, an increase in the younger forms, as noted in toxic and inflammatory conditions, constitutes a "shift to the left." On recovery, with increase in the mature cells, there is a "right nuclear shift."

Schilling[8] presents the scheme of Kohl and Sonnenburg for blood counts in acute appendicitis, counting as immature cells the sum of all granulocytes but segment forms:

Per Cent Immature Cells	Degree of Appendicitis
11–25	1st
25–45	2nd
45–60	3rd
Above 60	4th

TABLE I

HISTOLOGIC FINDINGS AND BLOOD COUNTS IN 71 CASES DIAGNOSED ACUTE APPENDICITIS

W.B.C.	Acute Inflammation 59 Cases		Non-acute 8 Cases				Normal Appendix 4 Cases			
	Cases	Neutrophiles Per Cent	Other Pathology		None Found		Other Pathology		None Found	
			Cases	N. Per Cent	Cases	N. Per Cent	Cases	N. Per Cent	Cases	N. Per Cent
30,000	8	71–98								
20–30,000	16	83–98	1	97						
15–20,000	17	76–97	3	77–87	..	.....	..	..	1	83
10–15,000	15	64–95	..	.....	4	60–87	1	97		
5–10,000	3	53–72	..	.....	..	.....	..	..	2	62–74

Kohl and Sonnenburg found this to agree with the severity of the case, with indication for operation, and with the prognosis. Schilling would consider the differential count before leucocytosis: a normal percentage of young neutrophiles arguing against infection, despite leucocytosis.

Goodale and Manning[9] report on 40 cases of appendicitis, comparing Schilling's differential count with histologic findings. They conclude acute appendicitis gives a definite left nuclear shift while nonacute appendicitis gives a negligible or no increase in young forms. Yaguda,[10] in retrospect, studied the Schilling differential in 671 cases of appendicitis, 214 of which showed acute inflammation histologically. He declares that a normal percentage,

2–8 per cent, of immature granulocytes rules out appendicitis; 8–14 per cent indicates a mild process limited to the mucosa; above 14 per cent indicates diffuse suppurative appendicitis; above 35 per cent indicates perforation with peritonitis.

Table II

HISTOLOGIC FINDINGS AND BLOOD COUNTS WITH SCHILLING'S DIFFERENTIAL COUNT IN 116 CASES DIAGNOSED ACUTE APPENDICITIS

Acute Inflammation 100 Cases				Non-acute 6 Cases						No Pathology in Appendix 10 Cases					
W.B.C.	Cases	N.	I.N.	Other Pathology			None Found			Other Pathology			None Found		
				Cases	N.	I.N.	Cases	N.	I.N.	Cases	N.	I.N.	Cases	N.	I.N.
30,000	2	86–87	32–41	..	.....	.....	..	..	..	1	90	30			
20–30,000	35	74–97	7–62	..	.....	.....	1	83	22	1	97	42			
15–20,000	34	71–94	11–64	..	.....	.....	..	..	..	4	73–92	15–35			
10–15,000	23	43–95	3–72	2	72–95	18–79	1	49	4	1	84	16			
6–10,000	6	61–87	8–57	1	77	23	1	60	4	1	77	48	2	62–66	9–10

N., Neutrophiles.
I.N., Immature neutrophiles.

being already interested in these comparisons of blood counts with diagnosis, each Schilling differential was finished and reported together with the white count. Thus the entire hemogram was available to the surgeon in making his diagnosis. If the extended differential were worth the extra time required it was hoped the number of nonacute appendices

Table III

COMPARISON OF FIRST AND SECOND SERIES ACCORDING TO HISTOLOGIC PATHOLOGY

	1st Series: Preoperative routine— W.B.C.: differential count				2nd Series: Preoperative routine— W.B.C.: Schilling's differential					
Diagnosis	Cases	W.B.C.	N. Per Cent	G. Per Cent	Cases	W.B.C.	N. Per Cent	G. Per Cent	I. Fer Cent	Avg. I. Per Cent	Sch. N.I.
Acute appendicitis.	28	6,600–38,900	64–98	36	35	6,800–30,000	60–96	60	3–54	27	3.4
Acute, with gangrene, peritonitis or periappendicitis, but not perforated.....	31	7,600–39,000	53–98	55	59	9,200–25,000	43–97	61	7–72	31	2.4
Acute, with perforation.....	..	.....	.....	..	6	18,000–32,000	83–91	50	23–57	45	1.1
Non-acute appendicitis.....	35	6,000–20,000	49–91	30	53	6,000–15,000	44–88	10	4–32	13	5.1

N., neutrophiles; G. cases whose blood counts show ascending Gibson's line; I. immature neutrophiles: Sch. N.I., Schilling's nuclear index.

To determine the helpfulness of the immature neutrophile count as a routine preoperative procedure, several surgeons

removed as acute would be diminished in the second series.

In the second series the acute cases confirmed by tissue sections increased from 83 to 86 per cent. Leonard and Dalrymple[11] also report a discrepancy of 14 per cent between clinical diagnosis and tissue findings.

There were 116 appendices (Table II) removed as surgically acute, 55 as non-acute. In two other cases no excision was made, drainage alone was attempted. Of the 116, 6 showed only chronic or recurrent inflammation, histologically, and 10 showed no micropathology. Eight of these 10 showed leucocytosis, neutrophilia and a definite left shift. In due time sufficient pathology was found elsewhere in these patients to explain the increased blood counts. The other two cases had neither leucocytosis nor neutrophilia; young neutrophiles were 9 and 10 per cent. Three of the non-acute cases showed other concurrent pathology. Two of the remaining 3 showed 8000 and 11,000 white cells, less than 65 per cent neutrophiles, less than 5 per cent stab forms. The third had 25,000 white cells, 83 per cent neutrophiles, of which 22 were immature; sections showed advanced chronic obliterative appendicitis.

As to its incidence in the second series leucocytosis occurred in 94 per cent of all the proved acute cases. As to degree of leucocytosis this series disclosed 71 per cent with more than 15,000 white blood cells, and 6 per cent with less than 10,000; neutrophilia above 75 per cent occurred in 84 cases out of 100. Neutrophiles under 70 reached 12 per cent as compared with 5 per cent in the first series. A rising line on Gibson's chart was observed in higher percentage in the acute cases and in a lower percentage in the non-acute. No explanation is offered for this except the longer series of observations. But more repeated counts were carried out in the second series in studying neutrophilic shift, and most of these last counts were taken within one-half to two hours before surgery.

Table IV indicates that out of 100 acute cases confirmed by section, 9 did not show increase in immature granulocytes above a normal physiologic range. Of these 9, 5 were with white counts of 10,000–15,000

TABLE IV

IMMATURE GRANULOCYTES IN APPENDICITIS
(Kohl-Sonnenburg's Scheme)

Acute cases								
Degree of Appendicitis:		1st	2nd	3rd	4th			
W.B.C.	Cases	3–10 Per Cent	11–25 Per Cent	25–45 Per Cent	45–60 Per Cent	60 Per Cent	70 Per Cent	80 Per Cent
20–30,000	37	1	10	20	5	1	1*′	1*′
15–20,000	34	1	10**	17	4	1*		
10–15,000	23	5	10*	5	3	..	1	
6–10,000	6	2	3	1*(57)				
Total cases	100	9	33	43	12	2	1	
Non-acute cases								
15–20,000	1	1						
10–15,000	19	7	11	1				
6–10,000	33	12	21					
Total cases	53	20	32	1				

* A death. ′ No excision.

and 2 with counts below 10,000. But 3 of the 9 showed the ascending line on Gibson's chart.

While there appears a wide range of immature polymorphonuclears, Tables III and V signify that the high percentages may be of more help in diagnosis than the low ones. Acute appendicitis was accompanied by an average percentage of 27 immature cells; acute appendicitis with gangrene, 30 per cent; with peritonitis, 31 per cent; periappendicitis, 32 per cent; perforation, 45 per cent; while the average for non-acute appendicitis was 13. Most of the counts for these non-acute cases ranged from 4 to 24 per cent immature forms. Only one having more than 30 per cent was discharged from the hospital with no other pathology found.

A few instances where the blood findings were known to have influenced the surgeon might be noted:

Case XVIII. Woman, ill at home for twelve hours with pain in the abdomen, especially in right lower quadrant. No fever nor other symptoms. Unless blood count were high, patient would be left under observation another twelve hours, until morning. Blood count showed 12,000 white cells; 95 per cent neutrophiles including 47 per cent stabs and 2 per cent juveniles; eosinophiles absent; divergence of 13 units upward on Gibson's chart. Patient was immediately brought to the hospital and operation performed. Sections showed acute catarrhal appendicitis. Next morning blood count showed 9900 white cells, 87 per cent neutrophiles, including 46 per cent stabs; the second morning 11,000; 73 per cent neutrophiles, 26 per cent stabs. Uneventful recovery.

Case XIX. Young woman admitted to hospital at 9 P.M. with severely acute pain over entire abdomen, tending to localize in appendiceal region. Temperature 100°F., pulse 100, respirations 24, no nausea nor vomiting, ill for past ten hours. White count, 7400, neutrophiles 68 per cent, including 55 per cent stabs, 2 per cent juveniles. This gave a descending line of 5 units by Gibson's chart, with a normal white cell count. Only the Schilling differential count suggested an acute condition, but because this factor had not been followed long at this time, immediate surgical intervention was not deemed necessary: another count was ordered for 8 A.M. This count showed 10,000 white cells, 85 per cent neutrophiles, including 66 per cent stabs and 6 per cent juveniles; Gibson's line ascending 11 points. By Kolh-Sonnenburg's scheme this predicted appendicitis of the fourth degree. Other symptoms remained as before. On taking the patient to surgery, the surgeon remarked that his action was based on the blood findings. Diagnosis at operation: Ruptured appendix with peritonitis; abdomen full of free fluid. Sections showed acute diffuse appendicitis. Blood count twenty-four hours later: 7600 white cells, 70 per cent neutrophiles, 53 immature forms; 72 hours later: 6300 white cells, 69 neutrophiles, 37 immature forms, eosinophiles reappearing.

The value of repeated counts before surgery is further illustrated below:

Case XXIII. Blood count: 10,400 white cells, 79 per cent neutrophiles, 8 per cent immature forms, 1 per cent eosinophiles; four hours later, 21,000 white cells, 92 per cent neutrophiles, 24 per cent immature, 1 eosinophile. Sections: acute diffuse appendicitis.

Case LXX. White cells 12,000; 82 per cent neutrophiles, 18 per cent stabs; five hours later, 12,300 white cells, 78 per cent neutrophiles, 28 per cent stabs. Sections showed acute ulceration, diffusing, with wall necrobiosis. In the second instance, Gibson's line was descending at the second blood count, while the Schilling differential indicated a shifting to the left.

In four instances cited in Table IV, first column, the immature cells ranged from 3 to 8 per cent at surgery. From Case XXIII, we might predict a rise in four or five hours. But 2 of these 4 showed peritonitis and gangrene on sectioning the appendix; one with 10,000, the other with 20,000 white cells. Another, with 9 per cent immature cells, in a white count of 13,000 showed beginning peritonitis. These exceptions point out the inadvisability of allowing a low Schilling count to delay surgery when clinical data warrant the operation.

A final consideration for interpreting the blood count is the nuclear index, figured by dividing the mature granulocytes by the sum of all the immature. Gerard and

TABLE V

IMMATURE NEUTROPHILIC GRANULOCYTES
WITH REFERENCE TO SEVERITY OF APPENDICITIS

W.B.C.	Cases	Acute Appendicitis			With Gangrene			With Peritonitis			With Periappendicitis			With Perforation		
		Cases	I.	Avg.	Cases	I.	Avg.	Cases	I.	Avg.	Cases	I.	Avg.	Cases	I.	Avg.
20–30,000	37	11	12–54	33	9	7–62	29	21	7–62	30	3	28–50	40	3	33–50	42
15–30,000	34	11	9–37	26	10	15–57	35	15	11–57	35	8	12–64	30	3	23–64	48
10–15,000	23	9	3–52	25	6	8–39	23	11	8–72	28	1	16	16			
6–10,000	6	4	9–23	15	..	.....	..	2	8–57	32						
Avg. immature neutrophiles.....		27%			30%			31%			32%			45%		
Avg. Schilling's nuclear index....		3.4			2.6			2.4			2.3			1.1		

I., immature neutrophiles.

TABLE VI

APPENDICITIS—FATAL CASES

Lab. No.	Clinical Data	W.B.C.	G.	Differential Count						Tissue Sections
				N.	M.	J.	St.	Seg.	Eos.	
LXXXVII	Acute, probably ruptured. Ill for 6 days, better, up, and out, then worse. Age 8.	25,000	‖	90	2	20	58	10	0	No excision. Death in 8 hours. No autopsy.
CLXIV	Acute with perforation and peritonitis. Ill 4 days.	29,000	des.	82	4	34	35	9	0	No excision. Death in 12 hours. No autopsy.
CLXVI	Acute, gangrenous, ruptured. Ill, 4 days.	29,100	des.	91	0	1	32	58	0	Distal acute with necrobiosis and perforation.
CV	Acute; peritonitis.....	13,500	asc.	83	0	0	18	65	0	
	4 hours later.....	11,000	des.	72	0	0	17	55	1	Acute diffuse; beginning peritonitis.
	5th day postop.....	5,300	des.	68	0	0	30	38	1	
	6th day postop.....	5,700	asc.	66	0	0	33	33	0	
	7th day postop. Died									
XCII	Acute; 2 months after normal delivery.....	13,400	asc.	95	0	10	69	16	0	Chronic catarrhal.
	2 days later.....	11,500	asc.	94	0	8	52	34	0	
	3 days later, died.....	14,500	asc.	91	0	8	59	24	0	
XX	Obstetric case, day of delivery..	17,100	.....	83	0	0	27	56	0	
	5 days later.....	9,300	asc.	92	0	4	45	43	0	
	5 hours later; acute appendicitis	9,800	asc.	87	1	11	45	30	0	Acute diffuse; peritonitis.
	1st day postop.....	12,800	asc.	96	1	14	52	29	0	
	2nd day postop.....	8,200	asc.	84	3	35	34	12	0	Staphylococcus from blood culture.
	3rd day postop. Died.....	5700	asc.	87	2	19	41	25	0	
LVIII	Ruptured, with adhesions.....	16,800	asc.	93	0	4	60	29	0	Acute diffuse; distal perforation; periappendicitis.
	5 days later.....	22,000	des.	68	0	1	31	36	0	
CXII	Acute gangrenous, ruptured....	19,900	des.	83	0	3	20	60	0	Acute, diffuse; distal perforation; periappendicitis.
V	Acute.....	25,000	des.	84	..	..	..	..	0	Acute suppurative, with periappendicitis.

G., Gibson's line; N., total neutrophiles; M., myelocytes; J., juveniles; St., stab forms; Seg., segmented forms.

Boerner[12] recommend it as a more definite determination of degree of "shift to the left," being a quantitative rather than qualitative method. The normal index is 15 or above in adults, according to Schilling. Gerard and Boerner found it much lower in children under four years of age. Tables III and V show this index consistently reduced according to severity of appendiceal involvement.

Fatal Cases (Table VI). Out of the entire 277 cases of appendicitis there were 9 deaths. In two instances, Cases LXXXVII and CLXIV, Table VI, the appendix was not removed, and confirmation of the diagnosis by section was not possible. These two patients had been ill four days. The blood counts were high, with extreme left shift, into the myelocytes. Mature granulocytes were only 9 and 10 per cent. Death occurred within twelve hours after surgery.

In one instance, Case CV, two preoperative blood counts had been made at a four-hour interval. The first showed 13,500 white cells, 83 per cent neutrophiles, 18 per cent stabs, no eosinophiles; the second, 11,500 white cells, 72 per cent neutrophiles, 17 per cent stabs, 1 eosinophile. Gibson's line, ascending 5 points at the first observation, was now descending 4 points, the Schilling count showed a right nuclear shift even in absolute numbers; but the nuclear shift index had dropped from 4.6 to 4.3. Sections showed acute diffuse appendicitis. No other blood count was taken until the fifth day after operation. Then there were 5300 white cells, 68 per cent neutrophiles, including 30 stabs. It was similar on the sixth day. On the seventh day the patient died from streptococcic peritonitis.

In Case XCII, the blood count on entrance to the hospital showed 69 stabs, 10 juveniles, in a white cell count of 13,000; neutrophiles 95 per cent. The neutrophilic granules showed distinct variation in size and in staining; many cells showed vacuolation of both cytoplasm and nucleus. The patient was very toxic, with temperature 103°F., pain and rigidity over the entire abdomen, more severe in the right lower quadrant. Operation for acute appendicitis was immediately performed. Sections showed only chronic catarrhal appendicitis. Young polynuclears did not drop below 60 per cent in the four days the patient lived. Blood culture yielded a small gram-negative bacillus, which grew with great difficulty in enriched media. Sufficient growth was not obtained for fermentation reactions, before it died out. The organism was not agglutinated by either typhoid or brucella immune serum. Autopsy was not secured.

It was observed that in no case where total immature cells reached 75 per cent, or where the differential count shifted to 10 or more juveniles, did the patient recover.

SUMMARY

In a series of 277 consecutive operations for appendicitis, 189 were diagnosed acute, 88 non-acute. Schilling's differential blood count was included as a preoperative routine in 173 cases, 104 had the usual white and differential count.

1. *Confirmation of Diagnosis.* Disagreement between surgical diagnosis and histologic sections occurred in 15 per cent of all acute cases, in 8 per cent of all non-acute cases. Where Schilling's differential formed a part of the preoperative examination, this disagreement was 3 per cent lower for acute appendicitis, and 2 per cent lower for non-acute, than it was in the series where the usual differential was used.

Normal appendices, removed as acute, were increased in the Schilling series, 1 per cent, forming 7.5 per cent of all acute cases.

2. *Leucocytosis.* (a) Leucocytosis occurred in 95.5 per cent of the proved acute cases, in 49 per cent of the non-acute. With the acute cases, leucocytosis was about the same percentage in each series; with the non-acute there were 15 per cent fewer incidences of leucocytosis where Schilling's method had been employed.

(b) Leucocytosis of 15,000 or more occurred in 71 per cent of all acute cases, in 5.4 per cent of all non-acute. The degree of leucocytosis was 21 per cent lower for acute, 5 per cent lower for non-acute in the Schilling series as compared with the first series.

3. *Neutrophilia.* Neutrophilia above 70 per cent occurred in 92 per cent of all acute cases, in 5.5 per cent of all non-acute. In the Schilling series the incidence was 7 per cent lower for acute, 5 per cent lower for non-acute cases than it was in the control series.

The ascending Gibson's line occurred in blood counts of not over 60 per cent of the acute cases, not under 10 per cent of the non-acute.

4. *Schilling's Differential.* Immature neutrophiles, in general, increased with the infection:

Degree of Appendicitis	Per Cent Immature Forms
Non-acute	Average 13
Acute	27
Acute with gangrene, peritonitis, or peri-appendicitis, not perforated	30
Acute with perforation	45

But only 58 per cent of the immature counts in acute appendicitis reached 25 per cent or more; 9 per cent were under 11 per cent immature forms.

CONCLUSIONS

Disagreement between surgical diagnosis and histopathology, as determined by section, occurs in acute appendicitis three times as frequently as does the lack of leucocytosis in the presence of microscopic pathology.

Leucocytosis is a constant symptom in acute appendicitis, more reliable than the degree of leucocytosis.

Schilling's differential count gives added information, particularly where the leucocyte count is not increased. Repeated Schilling counts are helpful in prognosis.

Surgical intervention in acute appendicitis should not be withheld for lack of leucocytic response alone, but when other concurrent pathology is excluded, increased blood counts should not be disregarded in the event of mild clinical symptoms.*

*Acknowledgement is made to Marie Killinger and Zana Skidmore for technical assistance; to the several physicians of this community who so generously assisted in securing necessary data, particularly to Dr. C. T. Moss, who in addition has criticized the work for its practical value to a surgeon; finally to my former teachers, Dr. H. G. Wells and Dr. Katherine Howell, for their criticism of text and tables, respectively.

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VALUE OF THE SCHILLING HEMOGRAM IN INFECTIONS

PRELIMINARY REPORT BASED ON 3500 CASES*

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"Klinischer and hämmatologischer Befund müssen zusammengehen."—Naegeli.

TO paraphrase Claude Bernard's well-known dictum: "true science teaches us to doubt and, in ignorance, to refrain," we may say that true science should teach us to doubt and try, while ignorance teaches us to doubt and refrain.

About four years ago one of us (A. A. E.), feeling that more information could be obtained from blood counts, if the latter were performed according to the method of Schilling, began to use this method routinely.

In presenting this preliminary report and our impression we are conscious of both quantitative and qualitative inadequacies, an entirely insufficient number of cases representing the former, and an insufficient number of counts on the same case constituting the latter; we feel, however, that even a small number of cases, if sufficiently diversified, permits us, if not to draw conclusions, at least to admit impressions.

The data herein gathered will probably make very little impression on that type of clinician, be he a surgeon or a physician, whose majestic self-assurance is ever unruffled, come what may. In an excellent article by Yaguda[1] there is this quotation of Hellwig: "Fowler's opinion that it is difficult to estimate the exact diagnostic value of the leucocytosis, is at the present time as true as it was in 1900." It is hardly possible to believe that any one could, even with the most superficial knowledge of clinical hematology, make such a statement today; yet Yaguda quotes a number of men, some of them well known, whose opinion of the value of blood studies to the surgeon is entirely negative. We must, therefore, bow to the fact that there will always be a group of clinicians who will refuse to accept the newer facts (we emphasize the word "facts") discovered by modern hematology, and who will continue missing, now and then, an occasional diagnosis, taking out an inoffensive anemic appendix which had never done anyone any harm, or leaving in the so-called "silent" suppurative appendices, or making sanguine prognosis only to find themselves confronted with the "sudden" death of that particular patient who "had been doing so well right along."

There is, however, another group of clinicians who have not made a fetish of "clinical judgment," infallible and error-proof; who welcome any help which has, as its sole object, the desire to shed light, whenever possible, on an obscure diagnosis, or on an uncertain prognosis; to add an element of certainty when diagnosis is wavering, and to sound a warning when complications arise before they manifest themselves clinically. To this group of clinicians who are always on the *qui vive*, who form a welcoming vanguard to a new fact or thought and who do not shut the windows to prevent a ray of light from entering the clinical judgment, to this group we dedicate the results of our investigations.

1. THEORETICAL

Adumbrating the summary at the end of the article we wish, at the outset, to point out the following impressions which, we believe, are justifiable:

1. The quantitative and qualitative studies of the "*Stab-zellen*" or, as we, in

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common with many others, have designated them, "band" or "staff" cells, are the most important parts of a blood count. It is in the recognition of the existence and of the importance of the band cells, the immature neutrophiles with non-segmented nuclei, that the Schilling[2] count (the written record of which is called "a hemogram") differs from an ordinary count.

2. The band cell count study is even more important in conjunction with the total leucocyte count and, as has been again recently emphasized by Medlar,[3] with the mature, i.e. segmented, neutrophiles, for it is the mutual relationship of these three elements: the total leucocytic count, the number of the mature (segmented) and of immature (band) neutrophiles, that reflects, mirror-like, the hematological reaction in the presence of infection.

3. By infection we understand not only diseases caused by bacteria and their toxins, but also all pathological conditions in which there is abnormal cleavage or breaking down and hyperabsorption of proteins, e.g. intestinal obstruction, degenerated uterine myofibromata, ulcerating malignant neoplasms, etc.

4. In many deep-seated infections, central pneumonia, deeply buried retrocecal appendicitis, etc., a properly performed blood count is of inestimable value in that it plainly and unequivocally points to the existence of a progressive infection, not only hours, but not infrequently, days, before the symptoms and signs permit one to form a definite clinical diagnosis.

5. A Schilling hemogram is of the greatest value in postoperative or metacritical recovery from a surgical or medical infection; the arising complications are reflected first (and often considerably earlier) in the blood count. We have seen patients who were discharged with a high band count (15–20 per cent*) only to return again within a few days, some with intestinal obstruction or peritonitis, others with empyema. We have become used to seeing patients who, while "doing fine," would suddenly show an alarming blood picture while, clinically, the reason for it would become obvious only some time, hours or days, later.

6. We have learned to appreciate not only the quantitative but the qualitative changes in the band cells. In severe infections the usual form of the band cell nucleus is that of a sausage, very plump and larger than in moderate infection; very frequently the nucleus is riddled with vacuoles, while the cytoplasm is studded with the so-called "toxic granules," large, dark and pleomorphic.

7. In a very small percentage of cases, not over 1 per cent, no hematological explanation of the surgical picture found at the operation could be vouchsafed, this discrepancy consisting both of the absence of hematological evidence of infection in the face of an adequate anatomical pathology, and of the absence of definite pathological changes in the presence of a suggestive blood picture (here we might add that there may have been pathological changes, but not demonstrated by laparotomy).

Theoretical Basis of the Schilling Hemogram. The epoch-making studies of Arneth (1904) which have established the morphological variability of the nucleus of the neutrophilic leucocyte, have naturally focussed attention afresh on the significance of the blood count.

True, Arneth's[4] own method has not and, probably will not, become an everyday laboratory procedure for several reasons. In the first place, Arneth's count is too complicated: there are five classes of cells, according to the number of the nuclear lobes, each of which has four or more configurations ("sausage," "bean," "ball"), giving a total of over twenty different neutrophile cells; the amount of time consumed by such counts is not the only objection; during the last twenty-five years Arneth has engaged in probably more polemics than any other hematologist, on purely theoretical grounds, and

* The normal band cell count is 5–8 per cent.

largely because he had gone too far in estimating the value of his classification. Schilling, Weidenreich, Pappenheim and Tuerk are some of his adversaries. One of the most serious arguments against accepting Arneth's teaching lies in the fact that he disregards the degenerative (qualitative) changes in the cytoplasm as well as in the nucleus (the presence of toxic granules, vacuoles, staining defects, etc.), in other words, he ignores all those changes which have been so well studied, recently, by Gloor.[5] For other objections to the acceptance of all of Arneth's tenets the reader is referred to the numerous articles by Schilling, Gloor and others.

In order to clearly understand Schilling's conception of the blood picture, it is useful to recall several physiological data.

In the mammalian bone marrow circulation is closed (Doan,[6] Sabin,[6] Cunningham, Drinker). The cells produced in the bone marrow are the erythrocytes, the thrombocytes (blood platelets) and the granular leucocytes: the eosinophiles, the basophiles and the neutrophiles; while the erythrocytes are formed intravascularly, the leucocytes are formed extravascularly; after the maturation has progressed from the myeloblast, through the promyelocyte to the myelocyte, and from the myelocyte to the metamyelocyte, the active migration of leucocytes into the blood vessels begins; in other words, normally the metamyelocyte is the first leucocyte to enter the vessels, due to the streaming of its granules; during this penetration a few metamyelocytes change into the band cells, of which all but 5–8 per cent mature into the segmented neutrophiles (mature neutrophilic leucocytes) in the peripheral circulation, and thus a drop of blood taken from the latter gives us the well-known normal differential formula of 70 per cent neutrophiles (62–65 per cent of segmented, and 5–8 per cent of band cells), 20–25 per cent of lymphocytes, 1–2 per cent of eosinophiles, 0.5 per cent of basophiles and 3–4 per cent of monocytes (the lymphocytes being formed by the lymphatic tissue, and the monocytes by the reticuloendothelial tissue).

The delivery of the cells from the bone marrow to the blood stream takes place, according to Shaw,[7] in two tides, one beginning in the forenoon, reaching its height in the afternoon and decreasing early in the evening, while the other tide begins late in the evening, reaches the maximum shortly after midnight and the minimum in the morning; these diurnal variations affect the total count but not the differential percentages. These facts should be carefully evaluated when checking up the blood counts made on the same patient at different hours, in order to do justice both to the patient and to the one who examines the blood.

The infectious agent apparently introduces either both a chemotactic and a maturation factor or a chemotactic factor only; in the former case a leucocytosis with a normal differential count results, while in the second case there will be, after a transitory leucocytosis, a progressive leucopenia, due to the fact that a lasting chemotaxis will gradually lead to exhaustion.

The exact mechanism of these two opposing factors is not yet known; it may be, as Noy and Eppler believe, that the stimulus to the bone marrow lies not in the direct chemotaxis by bacteria or their toxins, but in the increase of the body substances which normally stimulate the bone marrow; it may be that the normal splenic inhibitory hormone relaxes during the infective process, or it may be that with the increased phagocytosis a new stimulus for an increased production of the neutrophiles is furnished; at any rate, whatever the stimulus, it is a specific one for the neutrophiles, since the basophiles and, particularly, the eosinophiles promptly disappear at the onset of infection, and reappear when the latter is gone.

What regulates the delivery of the leucocytes under normal conditions? It is assumed that normally the production of the myeloid leucocytes (the neutrophiles,

basophiles and eosinophiles) is regulated, directly or through the sympathetic nervous system, by hormones; at least one of them seems to be produced by the spleen, and appears to be an inhibitory one; it is a matter of everyday clinical observation that most of chronic splenomegalies (Banti's disease, malaria, chronic tuberculosis, syphilis, Gaucher's and Pick-Niemann's diseases, Werlhof's disease, pernicious anemia, etc.), except the leukemias, are accompanied by leucopenia; some subacute splenomegalies (e.g. typhoid fever) are also characterized by leucopenia.

Naegeli has recently expressed an opinion that the resulting blood picture, both quantitative and qualitative, in infections, i.e. the toxic reaction of the blood, depends largely on the degree of mesenchymal affinity of the bacteria concerned in a given infection, pointing out that while the coccal infections produce intense changes in the blood pictures, infections which seem to have a marked predilection for the ectodermal nervous tissue (neurotrophic or neurophilic infections), such as Heine-Medin disease, tetanus, lethargic encephalitis, etc., are not reflected by any marked changes in the blood picture.

A word in connection with the splenic inhibitory hormone; it must be added that all other cellular elements produced by the bone marrow: the erythrocytes and the thrombocytes (blood platelets), are also under the splenic control, and E. Frank stresses the finesse and delicacy of the control manifesting itself beautifully in the fact that splenectomy causes an increase only or especially of that bone marrow element, the insufficiency of which constituted the most striking part of the preoperative hematological picture; thus, in pernicious anemia it is the erythrocytes, in Werlhof's disease the blood platelets (the thrombocytes), and in Banti's disease the leucocytes which so strikingly increase in numbers.

In passing we may mention Stephen's opinion that it is the adrenal cortex which, together with the splenic hormone, controls the hemopoietic functions of the bone marrow.

Finally, there arises the question of whether the splenic hormone controls the production of the cells or their maturation and release into the peripheral circulation; it is quite conceivable that the latter two phenomena may be under the pluriglandular control of the endocrines, so that the splenic hormone controls the production of the immature leucocytes, and the endocrines their maturation to neutrophiles, and the substances liberated by the dead, disintegrated neutrophiles (which substances are probably chemotactically identical with bacterial toxins) regulate the outflow of new neutrophiles to replace them.

To translate the foregoing physiological data into the clinical hematological picture, we may say that if the infection introduces both the chemotactic and the maturation elements, we shall have a leucocytosis and a normal differential count, if the infection is slight; if the infection gains, the neutrophiles, both the band and the segmented cells, will increase, as will the total leucocyte count; if the infection becomes severe, the maturation of the band cells into the segmented neutrophiles will lag, and the percentage of the band cells will rise, and that of the segmented cells will decline; from now on, as the infection gains in severity, the lagging maturation will manifest itself in the appearance in the blood of cells which are progressively less and less mature, i.e. there will appear, at first, the metamyelocytes (Schilling's "*jugendliche Zellen*"), then myelocytes and finally promyelocytes, and, occasionally, even myeloblasts, the latter event takes place but very seldom since the patients usually die before this happens. At the same time that more and more immature cells make their appearance, the signs of exhaustion begin to manifest themselves by the decreasing total leucocyte count, and the worst hematological prognosis is just this combination of the progressive decline of the total count and

the increase of the immature cells: the band cells, the metamyelocytes and the myelocytes.

Some infection, or rather infections in some individuals, the so-called "overwhelming" or "fulminating" infections yielding only the chemotactic but not the maturation element, lead to a very early exhaustion, the blood showing a low total leucocyte count and high increase in the band cells. This may be preceded by a very transitory leucocytosis, although in the most severe cases the bone marrow seems paralyzed at the very outset of infection.

We believe that as long as the band cells are under 15 per cent the infection is not suppurative, and if they are over 20 per cent, we are almost always confronted with pus or very grave intoxication due to hyperabsorption of broken-down proteins (intestinal obstruction, broken-down uterine myofibromata, etc.).

It is especially important to remember that *no one* count makes a hopeless prognosis; we have seen cases recover in which the band cells were as high as 60 per cent, and we have seen many cases die in which the band cells were only 30 per cent; it is the progressive rise of the band cells that spells the patient's doom, regardless of the clinical picture (see under Illustrative Cases). A patient who, during the postoperative or the metacritical pneumonic course, suddenly shows a rise in the band forms which persists or progresses, is developing a suppurative condition (an abscess, peritonitis, obstruction or empyema) no matter what the clinical picture is, because the latter always changes later than the blood picture. We have seen this time and again, but we have never seen the reverse, i.e. the occurrence of the clinical complications *before* the warning is sounded by the blood picture. Moreover we have repeatedly seen the patient leave the hospital quite well clinically, but with 15–20 per cent of the band cells, only to be readmitted a few days later with the aforementioned complications. (See Illustrative Cases.)

Another important point is to remember that with the onset of a severe infection or complication the eosinophiles disappear, and that with the onset of an improvement they always reappear, a most favorable sign.

Finally, the blood count in children, especially in very young children, requires a particularly careful observer, since the blood making and regulating apparatus in children is much less stable than in the adult.

2. ILLUSTRATIVE CASES

1. *Appendicitis.* This forms a large part of our series, comprising as it does 2143 cases: they are classified pathologically as follows:

	Cases
A. Chronic appendicitis	1192
B. Subacute appendicitis	234
C. Acute catarrhal appendicitis	369
D. Acute suppurative appendicitis (gangrenous, with or without abscess or peritonitis)	348

A. Chronic appendicitis shows a normal count:

		Average
Total W.B.C. count	6500–12,000	8500
Total neutrophiles	65–75 per cent	67 per cent
of which		
Band cells	2–6 per cent	4.5 per cent

B. Subacute appendicitis shows a slight increase in the total leucocyte count but the band cells are still normal:

		Average
Total W.B.C. count	10,000–17,000	13,000
Total neutrophiles	58–83 per cent	70 per cent
of which		
Band cells	4–10 per cent	7.5 per cent

C. Acute catarrhal appendicitis show a definite increase in the total leucocyte and neutrophile counts, and a slight increase in band cells.

		Average
Total W.B.C. count	10,000–23,000	18,000
Total neutrophiles	65–85 per cent	77 per cent
of which		
Band cells	8–18 per cent	11 per cent

D. Acute suppurative appendicitis shows a striking increase in all figures:

		Average
Total W.B.C. count	14,000–30,000	19,000
Total neutrophiles	75–94 per cent	84 per cent
of which		
Band cells	15–70 per cent	20.5 per cent

If the postoperative convalescence is uneventful, the band cells are the first to

return to normal; if a complication is setting in, the band cells either remain sustained or rise higher.

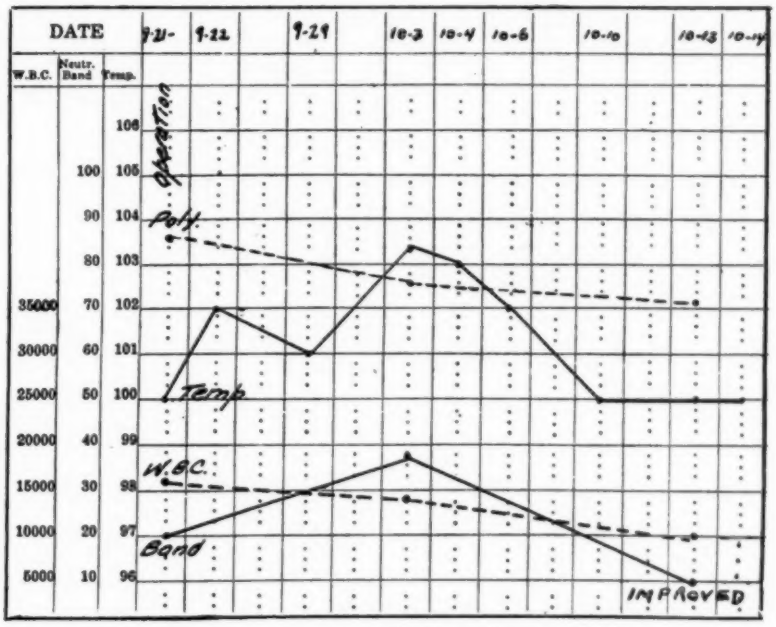

Chart 1. Acute gangrenous appendix in patient aged fifty-one years.

The following cases are selected to emphasize some particular point in diagnosis or prognosis:

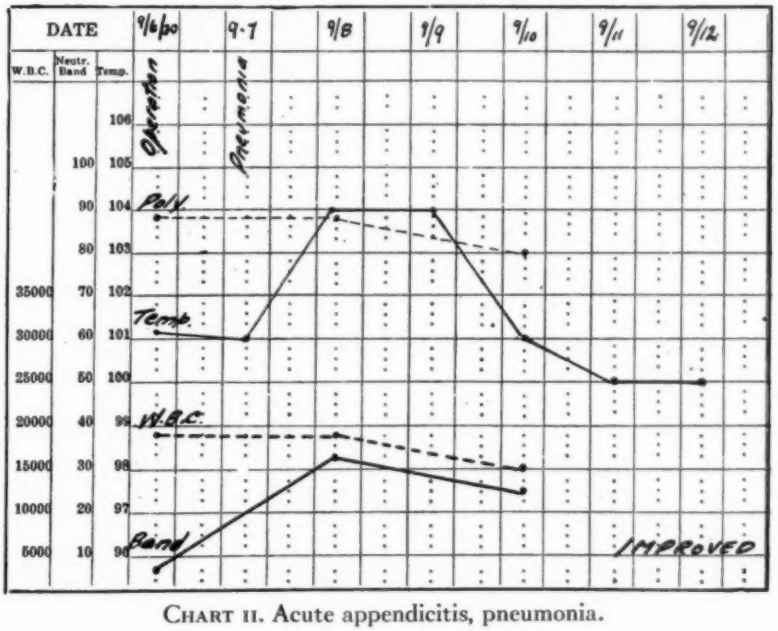

Chart 11. Acute appendicitis, pneumonia.

Case 1. No. 10667. A male patient, aged fifty-one, was admitted to Sydenham Hospital September 21, 1929, with symptoms referable to the right lower quadrant; his blood count showed: w.b.c. 16,000, neutrophiles 83 per cent, of which band cells were 20 per cent. A gangrenous appendix was removed; two weeks later, on October 4, w.b.c. were 14,000, neutrophiles 76 per cent, band cells 34 per cent; during this period the patient showed definite signs of peritonitis, which soon began to improve, and a week later, on October 12, w.b.c. were 10,000, neutrophiles 72 per cent, band cells 10 per cent. (Chart 1.)

Comment: The total W.B.C. and the total neutrophile counts were of no help, but the band cells showed a curve parallel to temperature, the two peaks coinciding on the same day (Oct. 3).

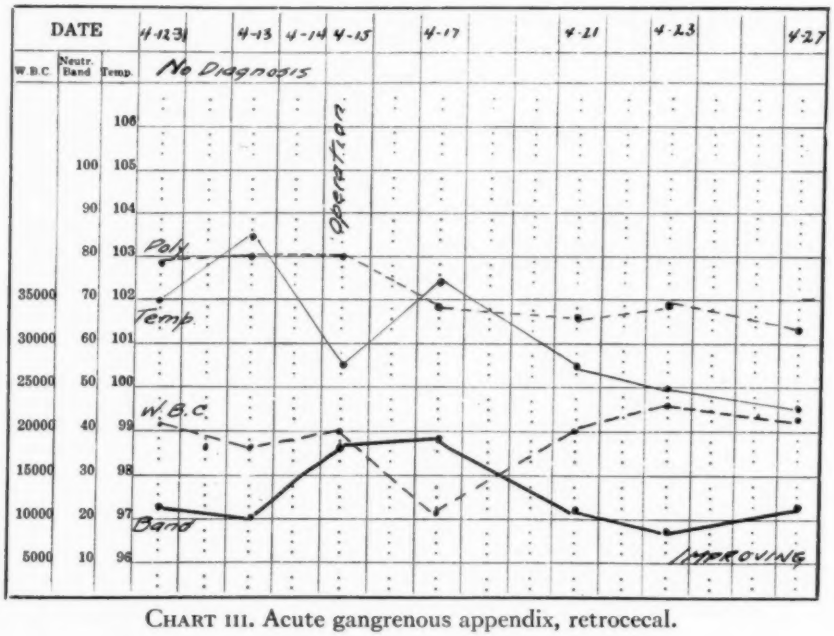

CHART III. Acute gangrenous appendix, retrocecal.

CASE II. No. 14966. This is a case of acute catarrhal appendicitis complicated by a postoperative lobar pneumonia. On admission the blood count showed W.B.C. 18,000, neutrophiles 81 per cent, band cells 7 per cent; two days later the temperature rose from 101° to 104°F., and his blood count showed W.B.C. 18,400, total neutrophiles 88 per cent and band cells 32 per cent. (Chart II.)

Comment: As in the preceding case, neither the total W.B.C. nor the total neutrophile count were helpful, while the band cells rose and fell with the temperature.

CASE III. No. 17440. This is an extremely instructive case, one in which clinical diagnosis completely failed to recognize the presence of an infection, while the hematological evidence was absolutely clear cut at the very outset.

A male patient, aged twenty, was admitted to the Sydenham Hospital April 12, 1931, with cramp-like diffuse abdominal pains of forty-eight hours' duration; there was a slight fever, and a slight spasm in the right upper quadrant.

Blood counts showed on April 12: W.B.C. 18,000, neutrophiles 80 per cent, band cells 20 per cent; two days later: W.B.C. 19,500, neutrophiles 80 per cent, band cells 36 per cent. Clinically, the patient's condition remained the same. On April 15, between the hours of 10 A.M. and 4 P.M. the patient was seen by three competent consultants: an internist, a surgeon and a gastroenterologist; their opinion was "hands off, no acute surgical condition present." Three hours later, an interne noted the rigidity of the abdomen; immediate operation revealed a ruptured gangrenous retrocecal appendix. Although clinically he began to improve immediately after the operation, the band cells persisted and five days later a mass was felt in the left flank, all this with no symptom or sign other than the sustained rise of the band cells. Resolution of the mass brought about a slow but uneventful recovery as well as a return of the blood picture to normal. (Chart III.)

Comment: While the temperature came down and the total W.B.C. and neutrophile counts remained stationary, the band cells remained sustained near 40 per cent, and came down when the total W.B.C. count went up, a most favorable prognostic point.

CASE IV. No. 13594. A male patient, aged twenty-eight, was admitted to the hospital on May 21, 1930, with symptoms of acute appendicitis. His blood count showed: total W.B.C. 60,000, neutrophiles 91 per cent, band cells 60 per cent, numerous toxic granules present. At the operation a gangrenous appendix with peritonitis was found. Three days later the

blood count was: W.B.C. 44,000, neutrophiles 62 per cent, band cells 50 per cent. Six days later the total W.B.C. count began to drop, while the temperature, the total W.B.C. and neutrophile counts were going down, while the band cells were going up. (Chart VI.)

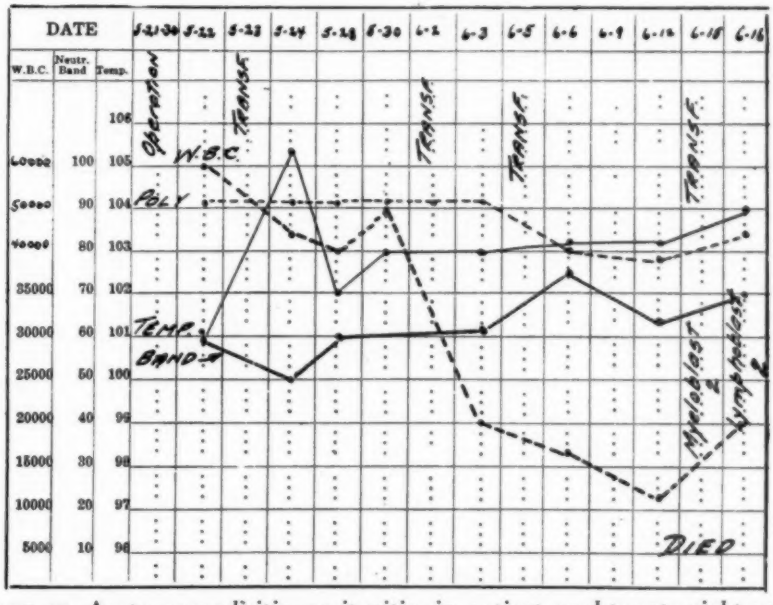

Chart IV. Acute appendicitis, peritonitis, in patient aged twenty-eight years.

while the total neutrophiles remained at 90 per cent and band cells at 60 per cent, a most serious and unfavorable phenomenon. (Chart IV.)

Comment: Observe the steady decrease in the total W.B.C. count and the persistent rise of the band cells, a combination usually pointing to a fatal issue.

Case V. No. 8799. This is a very interesting case, illustrating the desirability of examining the patients' blood when they are ready to be discharged, especially after an infective process. In this case, had it been known that the patient still had 20 per cent of band cells (and especially, that they had just risen from 8 per cent), the patient certainly would not have been discharged, but kept under observation. The patient had been operated on for acute catarrhal appendicitis, and was allowed to go home with a normal total W.B.C. and neutrophile count, as well as a normal temperature, but with band cells 20 per cent. He was readmitted two days later, his total W.B.C. and neutrophile counts rose moderately, but the band cells went up to 70 per cent; he died three days later of intestinal obstruction. (Chart V.)

Case VI. No. 14592. This case illustrates the fact that at times the band cell count may be the only factor pointing to a grave prognosis. One can readily see from the chart that the

2. *Cholecystitis.* Of gall bladder disease 672 cases were studied hematologically; 590 cases of chronic cholecystitis, and 82

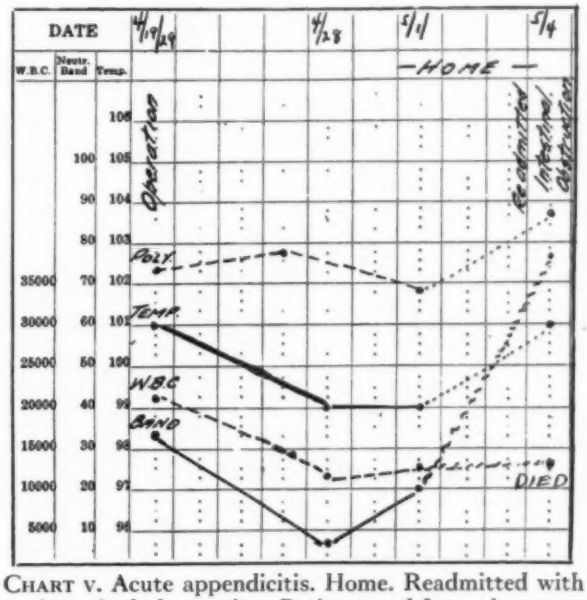

Chart V. Acute appendicitis. Home. Readmitted with intestinal obstruction. Patient aged forty-six years.

cases of acute cholecystitis.

We have found that the presence or absence of stones, adhesions, etc. does not

influence the blood picture, and that the latter is affected only by the presence or absence of infection.

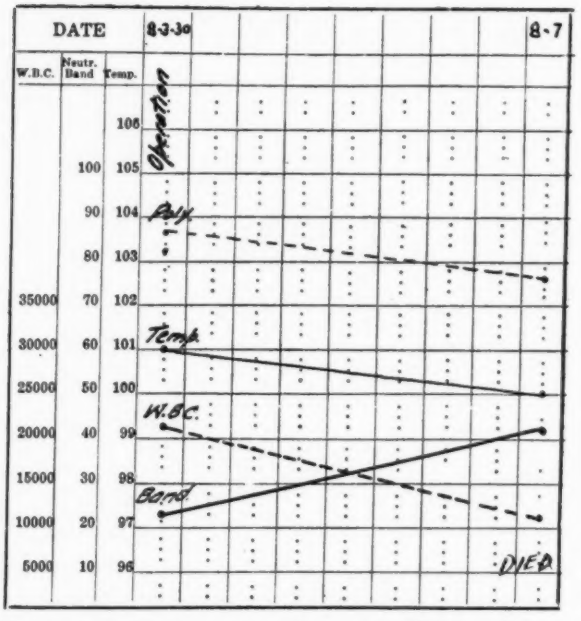

Chart vi. Acute suppurative appendicitis, abscess, peritonitis, in a patient aged sixty-two years.

In chronic disease the average count was:

Total w.b.c. count	9000
Total neutrophiles	69 per cent
of which	
Band cells	9 per cent

In acute gall-bladder disease the average count was:

Total w.b.c. count	18,500
Total neutrophiles	82 per cent
of which	
Band cells	22 per cent

Case vii. No. 7709. A female patient, aged sixty, was admitted to Sydenham Hospital on February 5, 1928, with symptoms of acute gall-bladder disease. Her temperature was 104°F. and the blood count moderately high. Under conservative treatment she improved, and was discharged. (Chart vii.)

Comment: The total neutrophile count remained high, but the temperature, total w.b.c. and band cells gradually came down to normal. This is a case which depicts the return to normal of an infected gall bladder under conservative treatment.

Case viii. No. 10382. In this case of clinically chronic cholecystitis in which operation was performed, the blood picture pointed postoperatively to acute infection, which became localized as a subphrenic absecss two weeks later. An interesting feature is the fact that all four elements: the temperature, total w.b.c. count, total neutrophile count, and the

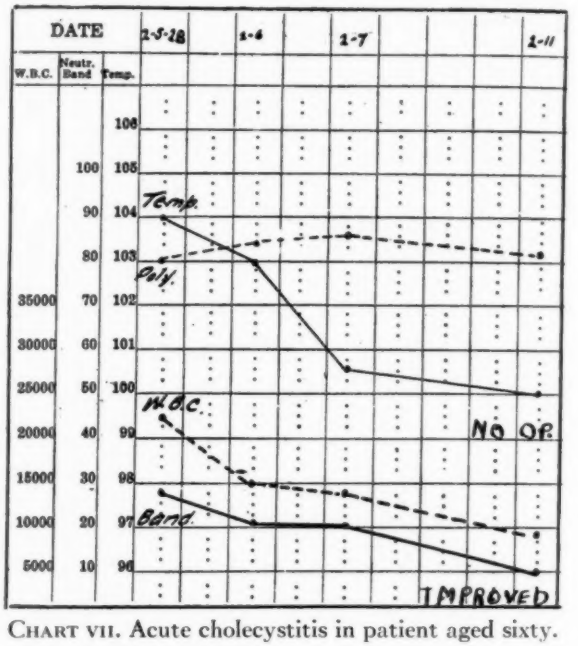

Chart vii. Acute cholecystitis in patient aged sixty.

band cells rose and fell in a parallel course. (Chart viii.)

Case ix. No. 14576. This is a case of acute suppurative cholecystitis in which the patient subsequently developed peritonitis. It illustrates very well the fact that while the band cell count was steadily and rapidly rising, and thus calling attention to the gravity of the situation, the total w.b.c. count remained unchanged, the total neutrophile count was decreasing, and the temperature rose only during the last three days. (Chart ix.)

Comment: Observe the false sense of security conveyed by the total w.b.c. and the total neutrophile counts.

3. *Intestinal Obstruction.* These cases show practically the same blood picture as is shown by pus infection; apparently hyperabsorption of toxic products of protein cleavage affects the blood-forming organs in the same manner as do bacteria and their toxins.

In 81 cases studied by us the average blood count was as follows:

Total w.b.c. count	20,000
Total neutrophile count	80 per cent
of which	
Band cells	30 per cent

Case x. No. 12426. In this case it is interesting to note that while the total neutrophile and the band cell counts reacted to the patient's condition, the total w.b.c. count remained practically unchanged. (Chart x.)

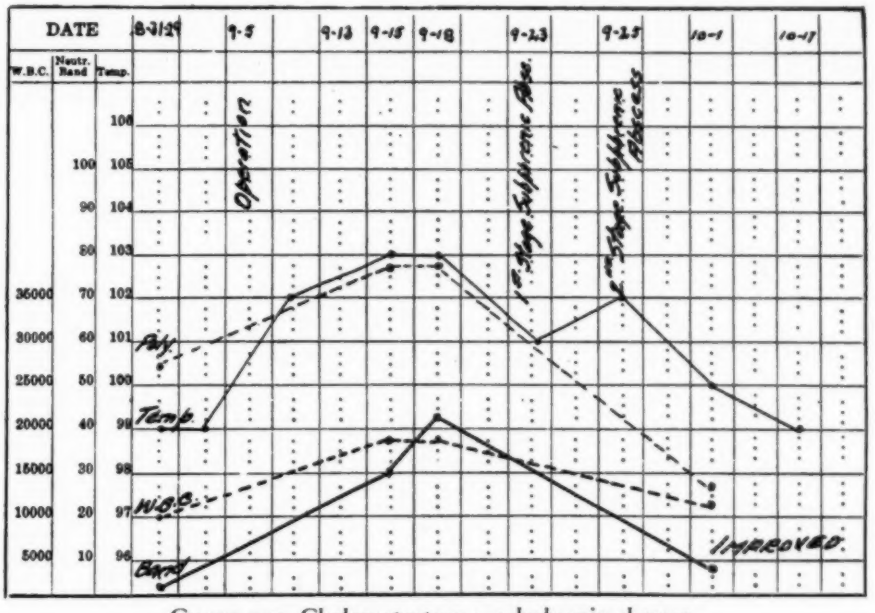

Chart viii. Cholecystectomy, subphrenic abscess.

Case xi. No. 22186. The interest of this case centers in the fact that although the clinical condition of the patient was not of sufficient severity to call for surgical interference during the first five days of illness, and although there was leucopenia during the first three days, the band cell count was persistently high: 40 per cent to 60 per cent, another instance of the grave significance of steadily decreasing total and increasing band cell counts. (Chart x a.)

4. *Lobar Pneumonia.* Of lobar pneumonia 210 cases were studied. The average blood count was as follows:

Total w.b.c. count	20,000
Total neutrophiles	85 per cent
of which	
Band cells	30 per cent

Hematologically, a moderately high total w.b.c. count, moderate total neutrophile and a low band cell count give a most favorable prognosis; the reverse: a low total w.b.c. count together with high total neutrophile and band cell counts, is of ill omen.

It also must be emphasized that if, after the crisis, the eosinophiles do not return, it means that there will be complications: empyema, pulmonary abscess, etc.

Case xii. No. 16784. This case illustrates the close parallelism between the temperature and the band cell curve, while the total w.b.c. and neutrophile counts appear irregular. Also observe an unfavorable picture during the first three days of illness before the serum was given: leucopenia with high band cell count,

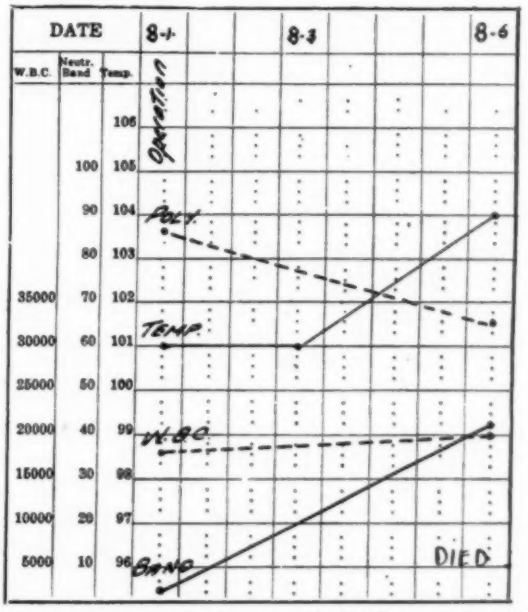

Chart ix. Acute gangrenous gall bladder, peritonitis.

and marked improvement after injection of serum. (Chart XI.)

Case XIII. No. 13588. A female patient, aged twenty-five, was admitted April 23, 1930, with a diagnosis of bronchopneumonia; the blood count on admission was as follows: total w.b.c. 17,000, total neutrophiles 74 per cent, band cells 14 per cent; after slight transient rise of all counts, the temperature dropped from 104° to 101°F., and the patient insisted on going home, in spite of the fact that the band cells were 16 per cent. She was readmitted two weeks later, the band cells still being 18 per cent, while the total w.b.c. and neutrophile counts had dropped. A small encysted empyema was discovered and treated surgically. (Chart XII.)

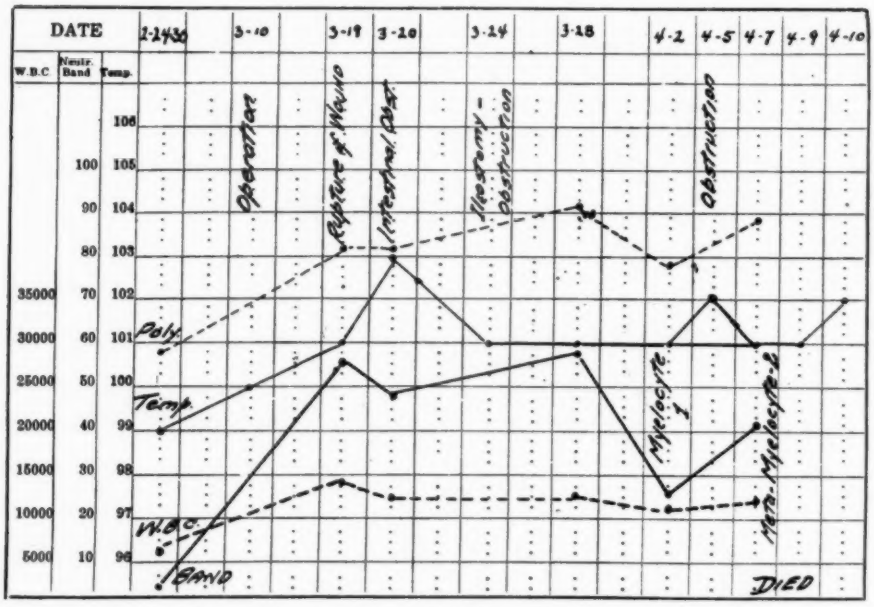

Chart X. Chronic appendicitis, rupture of wound, intestinal obstruction, peritonitis in patient aged thirty-three years.

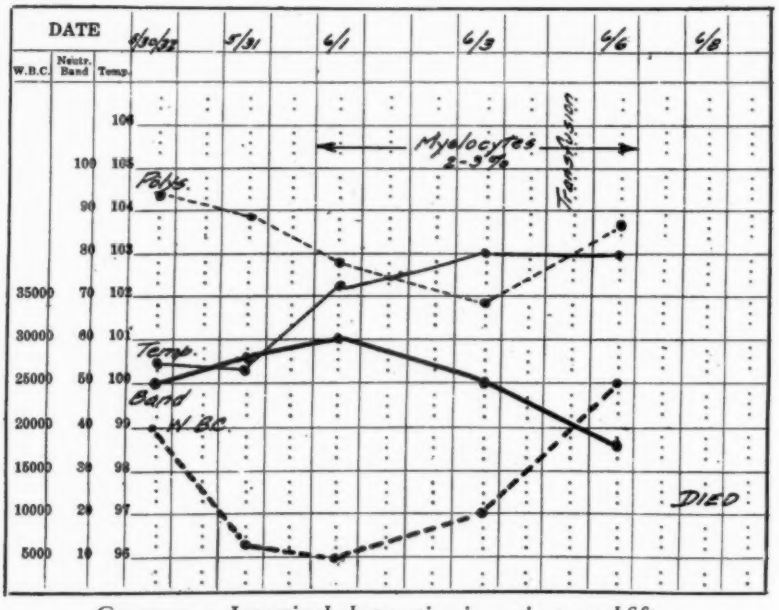

Chart X. A. Intestinal obstruction in patient aged fifty.

5. *Osteomyelitis.* Fifty chronic cases have shown nothing of consequence,

hematologically.

Acute osteomyelitis, 75 cases of which were studied by us, shows the following average blood picture:

Total W.B.C. count	20,000
Total neutrophiles	75 per cent
of which	
Band cells	20 per cent

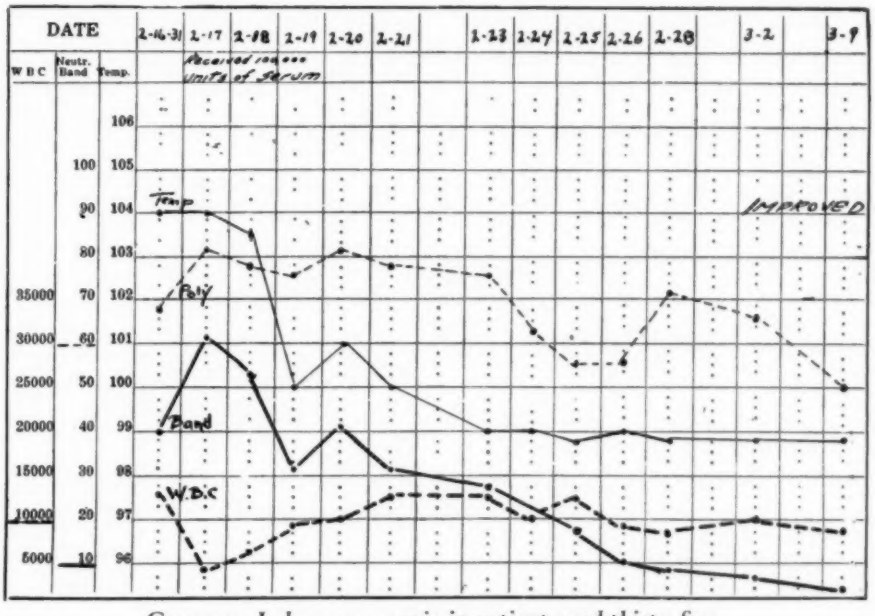

Chart xi. Lobar pneumonia in patient aged thirty-five.

On admission both ears were discharging, there was a swelling of the right thigh and an irregular fever. Blood count on admission showed: total W.B.C. 12,000, total neutrophiles 70 per cent, band cells 22 per cent; the patient was observed for two weeks with a provisional diagnosis of rheumatic fever, and at the end of this period there appeared signs of pus in the right hip. The blood count at that time showed the total W.B.C. 15,000, total neutrophiles 71 per cent, band cells 25 per cent;

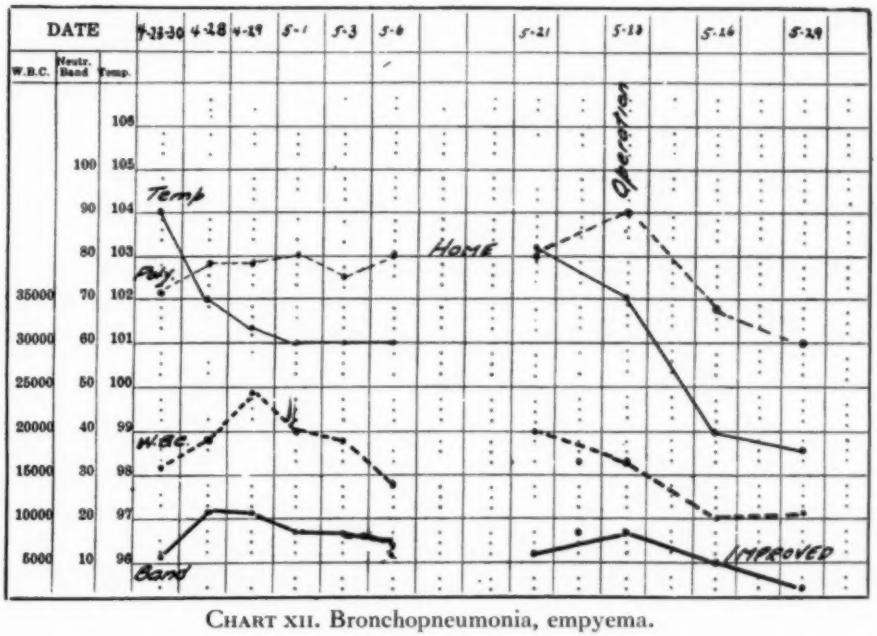

Chart xii. Bronchopneumonia, empyema.

Case xiv. No. 13076. J. R., aged two, was admitted April 12, 1930, with a history of lobar pneumonia two weeks prior to admission.

immediate operation revealed right pyarthrosis. The subsequent course was one of septicemia with metastatic manifestations and, finally, suppurative osteomyelitis of the mandible it is interesting to note that both the total W.B.C. and neutrophile counts were going down, while

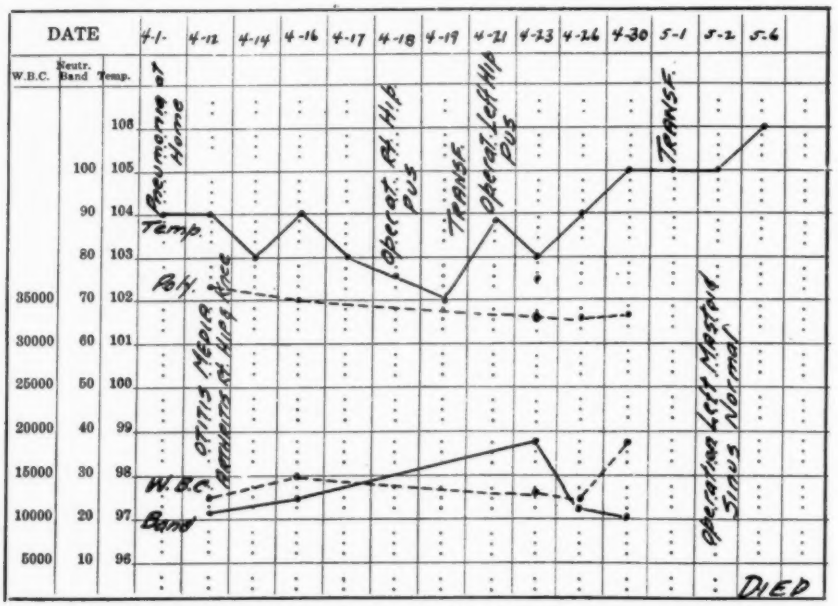

CHART XIII. Otitis media, septicemia, pyoarthritis of hip in patient aged two years.

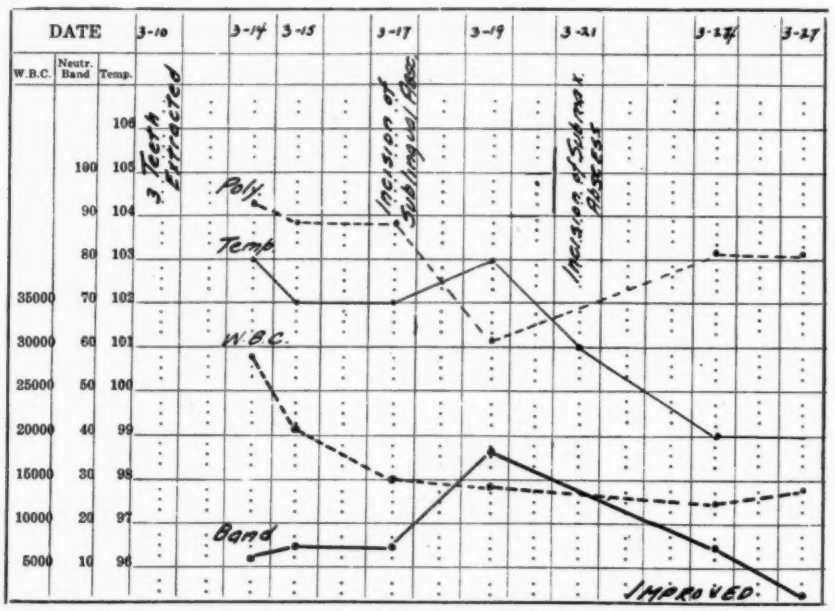

CHART XIV. Acute suppurative periostitis of mandible in patient aged twenty-five.

meningitis. (Chart XIII.)

Comment: Both the total W.B.C. and neutrophile counts showed a slight downward course, while the band cells steadily increased, a worthwhile point of differentiation between acute osteomyelitis and acute rheumatic fever, especially of the monoarthritic type.

CASE XV. No. 12716. In this case of acute the band cell count steadily pointed to the seprence of pus, in spite of the fact that the first incision did not reveal the presence of pus. (Chart XIV.)

6. *Mastoiditis.* Chronic infections of the mastoid do not produce a character-

istic blood picture; acute cases, 192 of which were studied by us, show the following average count.

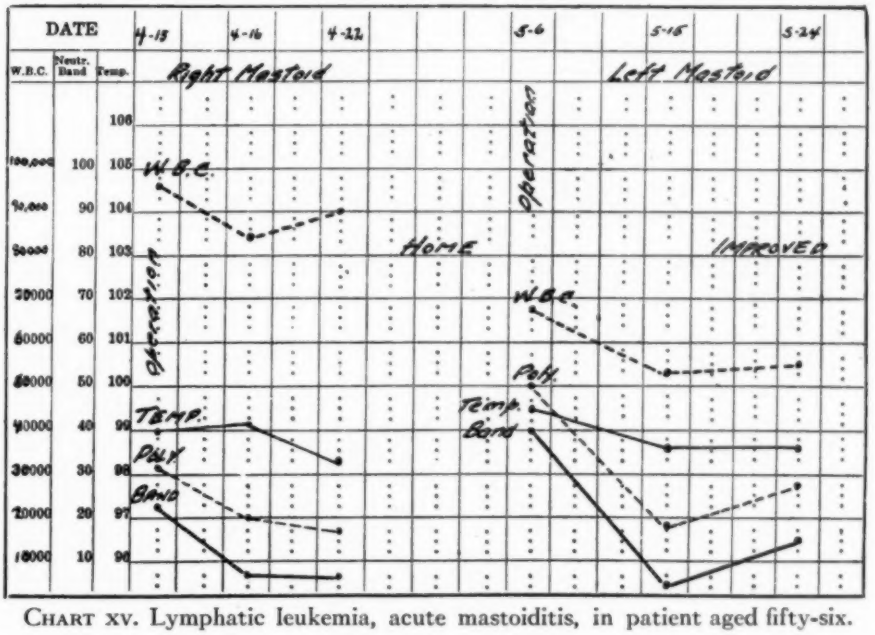

Chart xv. Lymphatic leukemia, acute mastoiditis, in patient aged fifty-six.

Total w.b.c. count..... 16,500
Total neutrophile count..... 68 per cent
of which
Band cells..... 15 per cent

it would have been impossible to determine the presence of an infection for the total w.b.c. count was 95,000, and the total neutrophiles were only 30 per cent; the reason for the former was, of course, the leukemia, and the latter, 30 per cent of neutrophiles, certainly did not point to infection. It was the band cells which saved the day, since of the 30 per cent neutrophiles, 22 per cent were band cells, i.e. over 65 per cent of all neutrophiles. (Chart xv.)

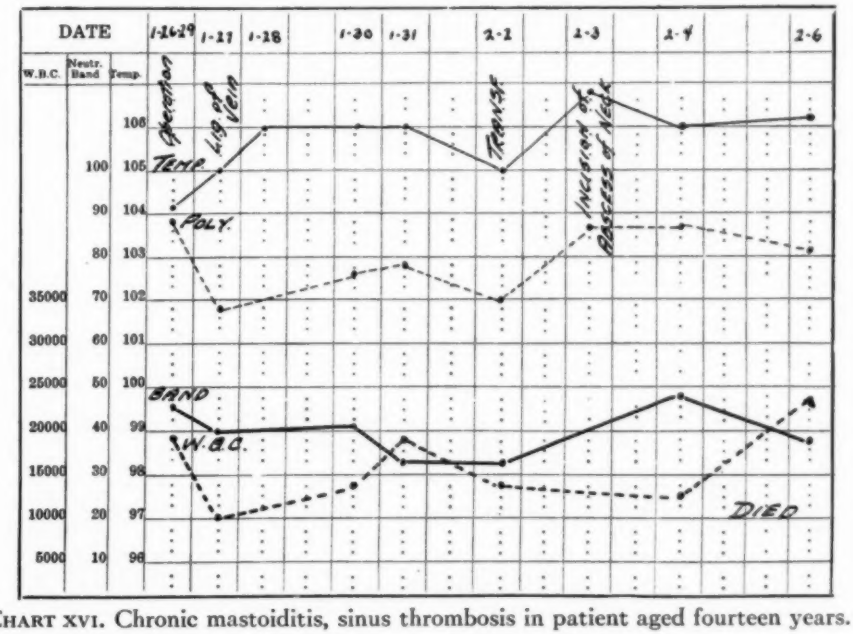

Chart xvi. Chronic mastoiditis, sinus thrombosis in patient aged fourteen years.

Case xvi. No. 8816. This case is of interest in that a patient suffering from chronic lymphadenosis developed a suppurative mastoiditis; according to the standard blood count,

Case xvii. No. 7577. This is a case of chronic and acute mastoiditis which developed sinus thrombosis; the total w.b.c. count was rather low: between 10,000 and 18,000, the total neutrophiles ranged between 68 and 90 per cent, while the band cells were persistently high between 35 and 48 per cent. (Chart xvi.)

SUMMARY AND CONCLUSIONS

1. With due respect to surgeons who are cited in the literature as expressing their opinions to the effect that the blood count gives no useful diagnostic information, we beg to differ with them and point out to them that they are missing much help by not familiarizing themselves with the modern blood count. The most experienced of them would save much diagnostic and prognostic grief by not ignoring the friendly aid offered by the hematologist.

2. The older method of blood counting which ignored the immature, non-segmented (staff or band) neutrophiles, does not offer anything like the information, diagnostic and prognostic, conveyed by the Schilling method, although the older methods of correlating the total leucocytic (w.b.c.) with the total neutrophile count, the Gibson and the Walker indices, are valuable.

3. The main practical feature of the Schilling count is the recognition of the non-segmented (band) neutrophile cell which normally constitutes from 4 to 8 per cent of all leucocytes.

4. If the infection is progressing, the most dependable hematological sign is the increase in the percentage of the band cells, regardless of whether the total leucocytic (w.b.c) count and the total neutrophile count rise or not; if the two latter counts are also high it is ever so much more favorable than when they are low, as this would point to the exhaustion of the hemopoietic activity of the bone marrow; in other words, the steady rise of the band cells points to invasive, progressive nature of infection, pus formation, and, if postoperative, to unfavorable termination; if they rise during an "uneventful" convalescence, medical or surgical, a complication or a recrudescence is present, regardless of the clinical appearance, since the latter may be delayed hours or days, as compared with the rise of the band cells, e.g. an abscess formation following an operation, empyema following pneumonia, acute exacerbation of a chronic mastoid, etc. When such rise in the band cells is accompanied by a fall of the total w.b.c. or neutrophilic count, or both, its unfavorable significance is greatly enhanced.

5. In especially severe infections there appear leucocytes more embryonic than band cells, viz. metamyelocytes, myelocytes and even myeloblasts.

6. The return of the eosinophiles—which, as a rule, disappear with the onset of infections, is always a most favorable sign, particularly in pneumonia—we have never seen pneumonia followed by empyema after a metacritical reappearance of the eosinophiles.

7. Just why in some infections all three counts: the total leucocytic (w.b.c.), total neutrophilic and band cell, are high, while in others only the band cell rises out of proportion to the former two counts, is not definitely known; the best explanation is that the infection introduces two elements: the chemotactic element which calls forth the cells from the bone marrow into the blood stream and to the site of infection, and the maturation element which hastens the evolution of the embryonic leucocytes to the stage of metamyelocytes, at which level the leucocytes migrate into the circulation and continue their process of maturation; if the infective agent carries with it the maturation element only, then the bone marrow will be forming cells which will not be called out into the blood stream; in either case the total w.b.c. count will be low, and the phagocytosis will be inadequate. This conception may explain why some diseases have, as their characteristic blood picture, a marked leucocytosis with a high band cell count, e.g. lobar pneumonia, while the characteristic blood pictures of others, is a

leucopenia with a high total band cell count, e.g. typhoid fever.

8. In the so-called "incomplete" clinical picture of acute appendicitis, cholecystitis, osteomyelitis, mastoiditis, and other surgical infections, as well as in pneumonia, typhoid, and other medical infections, the band cell count is of greater importance, pointing to any of these infections, when considered together with the clinical picture and taking the place of the missing symptoms; taken without the clinical picture the high band cell count points, non-specifically and without localizing it to a serious infection, probably suppurative, if the count is more than 15 per cent, and almost invariably so if it is more than 20 per cent.

We have seen central deep-seated pneumonias, retrocecal deeply buried appendices, and other "atypical" infections, giving a typical hematological picture days before they became "typical" clinically.

9. In less than 1 per cent of cases of discrepancy, the latter consisted, in a very large majority of cases, in the blood picture being one of infection, while the operation failed to show an anatomical reason for it. The answer to that is, of course, that surgical exploration of several organs had missed the site of infection, and not that there was no infection, only an autopsy could prove otherwise. In a few cases there was a clear-cut clinical picture of infection with a normal blood picture, and the course of the patient's sojourn in the hospital proved the correctness of the clinical picture; for this we have no explanation.

10. Finally, we wish to point out to those who are habitually hesitant in adopting anything that is "new," that in the first place, the Schilling count is not new any longer; in the second place, the clinician should clearly understand that the Schilling count is the ordinary blood count, such as has been done for the last thirty or forty years, except for two things, both extremely simple:

a. The immature (non-segmented, staff or band) neutrophile cells are separated from the segmented or mature neutrophiles (the familiarly known "poly" of yester-year), and,

b. The presence of occasional metamyelocytes or myelocytes should not be ignored, as it usually is, in non-leucemic cases, but should mean an even greater danger than the rise of the band cells; the more immature the blood cells, the more severe the infection.

We wish to acknowledge our sincere thanks to the members of the staff of Sydenham Hospital for their generosity in placing the records of their cases at our disposal. To Dr. Eugene E. Cahan of the Laboratory Staff we wish to express our deep gratitude for his valuable cooperation and interest in the work.

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THE RELATIONSHIP OF

ARTERIAL HYPERTENSION TO SURGICAL RISK*

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THE feeling that patients with hypertension are not good surgical risks has existed as a sense of uneasiness in the minds of both internists and surgeons, expressed by the surgeon by a desire for preoperative study of patients with hypertension, and by the internist or diagnostician by a more specific inquiry into the necessity for surgical intervention. It is justifiably true that when surgical intervention is urgent or necessary, little heed has been given to the hypertension. However, most patients who come to operation are afflicted with conditions that do not require immediate operation by virtue of the fact that their health rather than their lives is endangered. When inquiring as to the best procedure for the welfare of such patients with hypertension, it is well to know how they will tolerate major surgical procedures.

Butler, Feeney and Levine studied the records of 245 patients with disease of the heart but with systolic blood pressure below 160 mm. of mercury. There were 16 (5.9 per cent) unexpected deaths following operation. One hundred and forty-six patients with disease of the heart and systolic blood pressure in excess of 160 mm. of mercury were operated on, with 12 unexpected deaths (7.3 per cent). The authors concluded: "The height of the blood pressure has little influence on the mortality rate . . . even patients who had a very high blood pressure were, in general, good surgical risks." Sprague reported 6 cases of hypertensive heart disease in which operation was necessary. Three patients died, but the cause of death of only one patient (pulmonary edema) could possibly be traced to hypertension. O'Hare and Hoyt are of the belief that patients with high systolic and diastolic blood pressures are usually poor risks, but state that the condition of the blood pressure alone is not a safe indication of how well patients tolerate surgery.

CASES STUDIED

We studied the records of 350 patients with definite hypertension who had had major surgical operations at The Mayo Clinic. Cases of hyperthyroidism, prostatic obstruction, cardiac disease other than that due to hypertension, jaundice, diabetes and primary nephritis were excluded. The cases were grouped, according to the type of operation performed, as follows: radical amputation of the breast, 100 cases; cholecystectomy, 100 cases; hysterectomy, 100 cases; operations on the stomach and duodenum, 50 cases. Further grouping was made according to the height of the blood pressure as follows: Group A, systolic blood pressure between 180 and 220 mm. of mercury, or diastolic blood pressure between 90 and 110 mm. of mercury; Group B, systolic blood pressure between 220 and 240 mm. of mercury or diastolic blood pressure between 110 and 120 mm. of mercury, and Group C, systolic blood pressure 240 mm. of mercury or higher, or diastolic blood pressure 120 mm. of mercury or higher. Additional factors studied were age, renal function, electrocardiographic findings, changes in the ocular fundi, anesthesia, and mortality. When patients had been observed for a considerable time after operation or reliable letters of information were available,

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the condition of hypertension in relation to the health of the patients was studied. Of the 350 cases, 226 were in Group A, 88 in Group B, and 36 in Group C (Table I).

TABLE I
DECADES OF LIFE

	Blood Pressure		
	Group A	Group B	Group C
Third	0	1	1
Fourth	1	3	1
Fifth	38	14	13
Sixth	107	31	14
Seventh	66	34	4
Eighth	13	5	3
Ninth	1	0	0
Total	226	88	36

One hundred and eighty-four patients received the combination method of inhalation anesthesia, usually ethylene, nitrous oxide and ether; oxygen and carbon dioxide were added; 138 patients had ether anesthesia alone and 28 had spinal or regional anesthesia.

TESTS OF RENAL FUNCTION

The urine of 322 of the patients of the series was normal* for albumin, pus cells, blood and casts (Table II). Albuminuria, graded 2, hyaline or granular casts, blood or an abnormal amount of pus cells was present in the urine of the remaining 28 patients; renal function of 20 of these was adequate, as shown by a normal amount of urea in the blood. Six of the remaining patients were not submitted to further tests of renal function. In one case the concentration of urea was 44 mg. for each 100 c.c. of blood, and in one case the injection of phenolsulphonphthalein was followed by a return of only 25 per cent of the dye. Neither of these findings alone indicates impairment of renal function.

* The urine containing a trace or very small amount of albumin or pus cells as high in number as twenty-five in a high power microscope field were considered normal. Urine containing blood from the vagina was not considered abnormal.

TABLE II
TESTS OF RENAL FUNCTION

Urinalyses	Group A	Group B	Group C
Normal	214	75	33
Albuminuria graded 2	6[a]	11[b]	3[c]
Hyaline or granular casts	5[d]	1[e]	
Pyuria graded 4	1[f]		
Hematuria graded 1		1[g]	

[a] Blood urea was normal in two cases and was 44 mg. in each 100 c.c. in one case; return of phenolsulphonphthalein was 25 per cent in one case.
[b] Blood urea was normal in 9 cases.
[c] Blood urea was normal in all.
[d] Blood urea was normal in 3 cases.
[e] Urine contained some albumin and blood; the blood urea was normal.
[f] Urine not catheterized, blood urea normal.
[g] Blood urea normal.

Determinations of urea in the blood were made in 180 of the 350 cases. Normal figures were secured in 167 cases (Table III). Minor degrees of retention of urea were noted in 11 cases; in one case the concentration of urea was 65 mg. and in another 95 mg. with the return of phenolsulphonphthalein, 15 per cent, indicating definite impairment of renal function.

TABLE III
DETERMINATION OF UREA

Urea, Mg. in Each 100 C.c. of Blood	*Blood Pressure*		
	Group A	Group B	Group C
40 or below	104	41	22
41 to 50	6*	2	1
51 to 60	1		1
61 to 70	1†		

* Phenolsulphonphthalein excretion normal in 2 cases.
† In an additional case the urea was 96 mg. in each 100 c.c. of blood, the return of phenolsulphonphthalein by the kidneys was 15 per cent.

The return of phenolsulphonphthalein was observed in 111 cases and was normal in 91 (Table IV). In the 20 cases in which excretion of the dye was diminished,

determination of the blood urea gave normal figures in 12; in 7 it was undetermined, and in one case it was 96 mg.

The condition of the urine, the urea in the blood, and the return of phenolsulphonphthalein indicate that the function of the kidneys was normal in the majority of cases, reduced in a few, and definitely impaired in one case (Tables III and IV).

TABLE IV
RETURN OF PHENOLSULPHONPHTHALEIN

Per Cent	*Blood Pressure*		
	Group A	Group B	Group C
40 or above	56	24	11
39 to 30	7[a]	6[b]	
29 to 20	4[c]	1	1
19 to 10	1[d]		

[a] Normal blood urea in 6 instances.
[b] Normal blood urea in 3 instances.
[c] Normal blood urea in 3 instances.
[d] Blood urea 96 mg. in each 100 c.c.

MYOCARDIAL INSUFFICIENCY

Our evidence regarding the function of the myocardium is not extensive. Slightly abnormal increase of dyspnea on exertion was noted in several cases; edema was noted in only a few cases. There were no cases of congestive heart failure in this series, and the functional capacity of the myocardium was normal, or almost normal, in most cases.

ELECTROCARDIOGRAPHIC FINDINGS

The only electrocardiographic findings considered of significance were T-waves which were inverted or diphasic in other than lead III alone, heart block, bundle branch block, and auricular fibrillation or flutter. The electrocardiographic tracings were normal in all but 22 of 93 cases in which such tracings were made (Table V). Definite evidence of myocardial injury as a result of the hypertension was revealed in 22 cases.

TABLE V
ELECTROCARDIOGRAPHIC FINDINGS

	Group A	Group B	Group C
Normal*	49	15	7
Auricular fibrillation	3†	0	0
Inverted T-waves in lead I or II or both	4	2	4
Bundle or bundle branch block	2	0	0
Diphasic T-waves in lead II or III or both	4	3	0

* According to definition in the text.
† Inverted T-waves in 2 cases.

OCULAR FUNDI

Studies of the ocular fundi were made in 228 cases, and no variation from normal, arterial constriction, or a slight grade of arteriosclerosis was noted in 145 (Table VI). However, sclerosis, graded 2 and 3, was present in a considerable number of cases, in seven of which other signs of retinitis such as hemorrhage were seen. Malignant hypertension was observed in 2 cases.

TABLE VI
STUDIES OF THE OCULAR FUNDI

	Group A	Group B	Group C
No change in the arteries	32	8	1
Sclerosis graded 1 of arteries	53*	24	7
Sclerosis graded 2 of arteries	47	18†	9‡
Sclerosis graded 3 of arteries	3	1	5‡
Constriction of arteries	13	5	2
	148	56	24

* Other signs of retinitis in threes.
† Retinitis of malignant hypertension in two.
‡ Hemorrhage in two.

OPERATIVE DEATHS

The term, operative death, is used to include all deaths that occurred while the patient was under observation in the hospital. Nine patients died (2.6 per cent, Table VII). Four patients had had major gastric operations, with a mortality of 8

per cent; 2 died following cholecystectomy, an incidence of 2 per cent, and 3 died following hysterectomy, an incidence of 3 per cent. None of the patients died who had undergone radical amputation of the breast. In 4 cases death could not in any way be connected with renal or myocardial insufficiency. In 2 cases elevation of the level of the urea in the blood seemed a terminal event, and did not appear to cause the death of the patient. In 3 cases,

TABLE VII
OPERATIVE MORTALITY

	Hypertension		
	Group A	Group B	Group C
Parotitis	1		
Bronchopneumonia	1		
Pulmonary embolus	2	1	
Chronic nephritis with uremia	1		
Pancreatic insufficiency; gastric hemorrhage	1		
Cardiac failure and broncho-pneumonia	1		
Peritonitis; chronic nephritis		1	

renal and myocardial insufficiency and myocardial insufficiency with bronchopneumonia seemed responsible in at least a major degree for the fatal outcome, an incidence of 0.86 per cent of all patients operated on. The ages of these 3 patients were seventy-one, sixty-six and sixty-seven years, respectively. Two of these patients had only mild hypertension, that is, they were in Group A, and one patient, in Group B had moderately advanced hypertension. Pulmonary embolism was the cause of 3 deaths, slightly less than 1 per cent of all patients operated on and 33 per cent of all deaths. Two of these patients had had spinal anesthesia.

RESULTS

Seventy-six patients of the entire group were observed or were heard from within two years after operation.* Thirty-five of these were either dead or incapacitated, but the condition of only 7 was the result of hypertension (Table VIII). The condition of 51 patients was known by reëxamination or by communication between two and four years following operation. Eight of these were either dead or incapacitated, but only one from the result of hypertension, that is, heart disease. Within from four to six years after operation, the condition of 21 patients was known; 6 of these were either dead or incapacitated but only 3 from results of hypertension. The condition of 32 patients was known more than six years after operation; 13 of these were dead or incapacitated, but only 5 as a result of hypertension.

TABLE VIII
POSTOPERATIVE RESULTS

Condition When Last Observed or Heard from	*Years*			
	0 to 2	2 to 4	4 to 6	6 Years and Longer
Living and not incapacitated	41	43	15	19
Dead or incapacitated	18[a]	6[a]	1[a]	3[a]
	4[b]	1[b]	2[b]	2[b]
	10[c]	1[c]	2[c]	5[c]
	3[d]		1[d]	3[d]

[a] Recurrence or metastasis of malignant condition.
[b] Heart disease.
[c] Unknown and miscellaneous.
[d] Cerebral hemorrhage.

COMMENT

Operation was performed on 36 patients (Group C) whose systolic blood pressure was more than 240 mm. of mercury or whose diastolic blood pressure was more than 120 mm. of mercury, without a single death (Table VII). In 2 cases the blood urea was elevated (Table III) and in one case decreased return of phenolsulphonphthalein was observed (Table IV). In 4 cases there was definite evidence of myocardial injury (Table V), and moderate to severe sclerosis of the retinal arteries was observed in 14; in addition, hemorrhage and exu-

* The grouping in Table VIII is based on the latest information regarding the patients.

dates involving the retina were observed in 4 cases. Although marked renal or myocardial insufficiency was not present in any of these cases, our data show that if myocardial or renal involvement is slight as a result of severe hypertension, major operations can be carried out without additional risk.

Death occurred as a result of operation in 2 of 88 cases of moderate hypertension (Group B), an incidence of 2. 2 per cent. In one case death was due largely to renal and myocardial failure; in the other case the fatal pulmonary embolism could not, so far as we know, be linked with the presence of hypertension. The group of the 86 cases in which recovery was complete included 2 patients with malignant hypertension, 5 with significant electrocardiographic findings, 7 with some reduction of return of phenolsulphonphthalein, 13 with albuminuria of a significant degree, or casts or blood in the urine, 2 with some increase in the urea in the blood, and 19 with moderate to advanced sclerosis of the retinal arteries. All of these patients withstood operation satisfactorily.

Seven of the 226 patients with mild hypertension (Group A) died as a result of surgical intervention, an incidence of 3.1 per cent. The hypertension was said to be responsible for only one death. Of the remaining 219 cases, moderate to advanced sclerosis of the retinal arteries was present in 50; electrocardiographic findings were significant in 13, reduced return of phenolsulphonphthalein by the kidneys was present in 12, some elevation of the urea in the blood was noted in 8, and significant changes were found in the urine of 11 patients.

The evidence here would favor the premise that the greater the hypertension the lower the surgical risk, as the mortality following operation of the patients with severe hypertension (Group C) was 0 per cent; of those with moderate hypertension (Group B) the mortality was 2.3 per cent, and of those with mild hypertension (Group A) the mortality was 3.1 per cent. However, many other factors such as age, small number of cases, obesity, and type of operation enter into consideration; the evidence that the height of the blood pressure bears an inverse relationship to the surgical mortality is no more than suggestive.

Comparison with Mortality in Unselected Groups of Patients. In Balfour's report on major surgery of the stomach for 1930, 27 deaths occurred in 860 operations, an operative mortality of 3.1 per cent. This is considerably lower than in our series of 50 cases in which there were 4 deaths, an operative mortality of 8 per cent. Our study does not indicate that hypertension was responsible for the increased mortality. Fifty cases is too small a group for statistical study, and many of the patients were operated on many years ago when the mortality from surgery of the stomach was much higher. Masson's report for 1930 stated that hysterectomy was done on 413 patients, with 11 deaths, an operative mortality of 2.3 per cent. This figure is somewhat lower than the 3.0 per cent in this series of 100 cases, but the difference is insignificant. The surgical mortality for cholecystectomy on 579 patients reported by Judd and Walters was 1.7 per cent, which is less than the 2.0 per cent mortality in this series of 100 cases, but the difference is insignificant. Harrington reported that radical amputation of the breast was performed on 223 patients in 1931 without any deaths; this is in agreement with our study.

Cases in Which Death Was Attributable to Hypertension. Operation was imperative in all 3 cases as all of the patients were suffering from carcinoma; in the first 2 cases the lesion involved the body of the uterus; in the third case the stomach was involved. Renal and cardiac studies were not adequate before operation in the first 2 cases in which operation was done in 1914 and 1915, respectively. The condition of the patient in one case was very poor. There was evidence of myocardial failure; the death of the patient after operation was

not unexpected. Operation was indicated in all 3 cases, as removal of the malignant tumors offered the only hope for life.

Length of Life Following Operation. When considering major surgical procedures for patients with high blood pressure, it is important to attempt a prognosis regarding hypertension. Obviously, operation for the relief of minor diseases is unwarranted if the remaining period of life is to be short. Our study indicated that this is the single consideration of significance. Surgical intervention might well have been refused the 7 patients who died within a period of two years after operation provided their deaths could have been predicted and provided operation was not urgent, as it is in the presence of malignancy, gastric obstruction or severe pain. Unfortunately, the length of life can only occasionally be predicted if hypertension is present. Certainly, in the cases reported here, in which renal and cardiac functions were good to fair, it was almost impossible.

Our data indicate that the 182 patients, whose conditions were known for a variable period following operation, survived the hypertension for a sufficient time to justify surgical intervention, with the possible exception of 7 who died or who were incapacitated as a result of hypertension within a period of two years after operation. Six of these were dead; and had had severe hypertension, or had given significant electrocardiographic findings. The living but incapacitated patient of this group had had mild hypertension.

These studies indicate the short life expectancy of many patients with severe hypertension, and the necessity for careful evaluation of the hypertension in any patient when surgery is considered. Patients with severe hypertension and evidence of myocardial degeneration have a short life expectancy. The surgeon and internist should exercise judgment when major surgical procedures are to be performed.

SUMMARY AND CONCLUSIONS

1. The records of 350 patients with hypertension, on whom major surgical procedures were performed were studied. The operative mortality for the group was 2.6 per cent. This is approximately similar to that of the mortality in a group of unselected cases in which the same surgical procedures are carried out.

2. Patients with all grades of hypertension without obvious or with mild myocardial and renal insufficiency, withstand surgery as well as those who are unselected.

3. Death occurred largely as a result of hypertension only three times, an incidence of 0.86 per cent.

4. Patients with severe hypertension frequently die within a period of two years after operation as a result of hypertension.

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RADIATION THERAPY OF RECTAL CANCER*

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TREATMENT of rectal cancer is a complex problem due to numerous variable factors encountered at the time a definite diagnosis is determined. Radiation therapy and surgery are the two methods of treatment which have proved to be of greatest value.

The surgical aspect of treatment need not be discussed here. Experience has proved that there is not any one method of treatment suitable for all cases of rectal cancer. Every case is an individual problem. Only by knowledge of the advantages and limitations of radiation therapy and the different surgical procedures can the most appropriate treatment be given to a miscellaneous group of cases.

Radiation therapy has been employed in rectal cancer for more than a decade. During this period the advantages and the limitations of the physical agents have been fairly well demonstrated. They are capable of producing clinical cures in selected operable and inoperable cases; they provide greater palliation in the advanced stages of disease than that offered by any other present-day method; they are a valuable asset when combined with surgical procedures. In fact, radiation therapy appears to have a wider field of usefulness in the treatment of rectal cancer than have radical surgical methods. By varying the dosage and technique of application this method may be appropriate not only for the early favorable cases but also for the more advanced stages of disease, that is, for the operable as well as the inoperable patient.

The types of radiation which are of greatest value consist of external application of radium and high voltage roentgen rays and interstitial application of gold filtered emanation seeds. In most instances both types are required, external applications constituting the first step of treatment. Radium applicators applied to the surface of the tumor and the insertion of radium element needles have very limited fields of usefulness and need not be discussed in detail.

Applications of radium should be looked upon as a surgical procedure and radiation therapy as an additional weapon in our surgical armamentarium against cancer. The surgeon, in order to select properly the treatment for his cases and obtain the greatest benefits from radiation therapy, must be familiar with the favorable and unfavorable effects produced by both external and interstitial applications.

External radiation of rectal cancer consists of external applications of high voltage roentgen rays and radium rays administered about the pelvis at several portals of entry. Roentgen rays, which are inexpensive and easily obtainable, are extensively used. Radium rays, however, appear to exert a more beneficial clinical effect in certain cases. External treatments may consist of either type of rays or a combination of both. The effects of these two different types of rays upon deep seated tumors will vary with the dosage which reaches the tumor. The tumor dosage depends largely upon the number of portals of entry about the pelvis, the distance that the tumor is situated from the skin surface, the target distance, the voltage, filter, time, and method of exposure. Except under the most favorable conditions it is impossible to provide sufficient dosage by either type of ray to cause complete disappearance of the tumor. We have at present one patient who has re-

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mained clinically free of proved cancer for a period of four years following external radiation alone.

The sublethal dosage, which can be administered to the primary mass by external applications, has a beneficial effect in most instances; the rectal discharge is lessened, the blood stains disappear, the area of ulceration is decreased, the tumor becomes smaller and the degree of mobility is increased. There is also improvement in the patient's general condition which is frequently accompanied by marked gain in weight and strength. The patient feels that he is getting better and has a brighter outlook on life. Fortunately, such improvement can be obtained in most instances without undesirable reaction. Occasionally patients who are in poor physical condition, or in whom dosage has been too large or administered at too frequent intervals, are the victims of a slight reaction. This is characterized by a feeling of malaise, loss of appetite or nausea. These symptoms usually last but a short period and the patient soon obtains the benefit from his treatments.

The implantation of irremovable gold-filtered radon seeds appears to afford the most efficient method of supplying uniform intensive irradiation to rectal cancer. These seeds are distributed throughout the tumor, special care being given to include all areas, particularly those beyond the rectal wall. The seeds are 4 to 5 mm. in length, 0.75 mm. in diameter, with a filter of 0.3 mm. of gold. Strength varies from 1 to 3 millicuries each.

The efficiency of the two methods and the indications for their use differ at times. Each method plays a distinct part in the radiation treatment in this disease. In the case of external applications the dosage at the site of the tumor is limited while with interstitial applications a cauterizing effect may be produced if desired. External application given about the circumference of the pelvis, produces about 100 to 175 per cent S.E.D. throughout the whole pelvis. The effect of interstitial implantation is confined to a comparatively small area about the implants. The distance of adequate radiation from an individual seed will depend upon its strength. The area of irradiated tissue, however, may be increased to any size by employing a larger number of seeds. The tissue dosage delivered to the whole tumor is governed by the total dosage and strength of the seeds. Interstitial radiation is commonly used as the second step of radiation therapy to supplement the sublethal dosage provided by the external applications. By varying the dosage of the two methods three different effects upon the tumor are possible: (1) growth restraint; (2) devitalization without necrosis or sloughing; (3) devitalization with necrosis or sloughing. The latter is a condition which is seldom desired in the treatment of this disease.

The effect of interstitial radiation upon the patient will vary largely with his physical condition, the total dosage employed, the degree of infection of the tumor and the involvement of adjacent structures. When cases are properly selected and the dosage is not beyond that required for devitalization of malignant cells the reaction is seldom severe unless more than 50 millicuries are implanted. Smaller dosages than the foregoing seldom produce severe reactions. The ordinary reaction which may be expected to follow adequate interstitial radiation in properly selected cases is never a contraindication to this form of therapy.

In order to obtain the greatest benefit afforded by radiation therapy, cases must be selected in accordance with the clinical and pathological factors of the case, and treatment given with a definite object in view. Indications for radiation therapy may be: (1) to produce complete disappearance of disease by this method alone (here a colostomy may, or may not be required to relieve obstruction); (2) to aid radical surgical procedures in producing complete disappearance of disease; (3) to offer palliation to patients in whom clinical cure is impossible. Dosage and technique of

application under these three conditions differ and will be considered separately.

Cases in which the disease can be eradicated by radiation therapy alone may be either operable or inoperable. The tumor, in either instance, must lend itself to adequate interstitial radiation. In other words, the cancer must be so located as to permit administration of adequate dosage to all malignant cells, and must still retain its original characteristics and not be altered to a marked degree by secondary infection. Moreover, patients must be able to withstand the reaction expected to follow the dosage of radium required for devitalization of the whole cancer.

When such circumstances are presented this method should receive preference over all others. Patients are saved the dangers associated with radical operations, they seldom require hospitalization for more than a few days, and in many instances they are left with a normally, or practically normally, functioning terminal intestinal tract. Because of the degree of obstruction which has taken place before treatment is begun, a colostomy is required in about 50 per cent of this group of cases.

In the routine procedure followed, when clinical cure is possible by radiation therapy alone, external applications, as the first step of treatment, are administered about the circumference of the pelvis at six portals of entry, and when the tumor is situated low in the rectum, a perineal field is added. Dosage to each portal consists of about 900 R units of roengten rays or a full erythema dosage of radium rays, with treatments given daily or on alternate days. Two to four weeks after completion of external applications, gold-filtered radon seeds are implanted. The period between procedures permits the following favorable changes to take place: improvement in the patient's general physical condition, better defining of the mass, decrease in ulceration and infection of the cancer together with reduction in size and fixation of the tumor. The degree of response to this form of therapy largely indicates the radio-sensitivity of the cancer. Providing patients are properly selected, the importance of calculation of dosage and distribution of radon seeds cannot be overemphasized. Success or failure frequently rests with these two factors. Total dosage is estimated from the size of the tumor and the radio-sensitivity of the malignant cells in question. The average dosage required will vary from 30 to 70 millicuries (3900 to 9100 mc. hrs.).

Radon seeds are distributed throughout the mass by means of long trochar needles. Actual placing is determined by direct vision through an electrically lighted speculum, or, in the case of low-lying tumors by the sense of touch. Even distribution of the seeds can be obtained only when the surgeon is familiar with the size and shape of the mass. The patient is placed in the position which offers the greatest accessibility. Anesthesia is seldom required.

Many of the unsuccessful attempts in the past to obtain clinical cures by radiation therapy in rectal cancer should undoubtedly be attributed to improper technique and not to the method of treatment.

It is questionable if the advantage afforded by the combined use of radiation therapy and radical surgery is fully appreciated. We are all familiar with the large number of cases which are thought to be operable but die within one, two, or three years from incomplete removal of the local disease. We feel that adequate preoperative or postoperative therapy offers this type of case a marked additional advantage. In certain instances all malignant cells which cannot be removed by dissection are completely devitalized by radium. Under less favorable circumstances when it is impossible to cause complete devitalization, their activity is curtailed for a much longer period of time. When preoperative therapy is employed the area of devitalized tissue is removed to prevent the reaction that may be expected to follow a massive dosage of interstitial radium. Technique of application in preoperative therapy is similar to that employed when

radiation therapy constitutes the only method of treatment. Special care is devoted to the placing of the seeds in the outlying areas of the indurated tissue. Technique of postoperative therapy consists of interstitial applications of radon seeds, at the time of operation, into malignant tissue which cannot be removed. If necessary external applications are employed at a later date.

Radiation therapy plays the major part either alone or in combination with a colostomy in the treatment of inoperable or advanced rectal cancer. Colostomy need not be employed routinely but only when obstruction is a troublesome factor. Irradiation offers the average inoperable case greater possibilities than any other present-day method. The principle followed is to make full use of external radiation and supplement this dosage when necessary by radon seeds. The initial dosage is determined by the patient's general condition, while future applications are governed by the progress of the case.

Patients are examined at frequent intervals and subsequent treatments administered. External applications are often repeated and may be given over a period of several years. Interstitial applications are occasionally repeated but only when small dosage has been employed in the beginning. The usual object of palliative treatment is greater comfort for the patient without untoward reactions. A number of advanced cases of inoperable carcinoma may be rendered clinically free of disease; others may enjoy a complete disappearance of symptoms for a varying period of time; with the less favorable groups only a regression of symptoms can be hoped for.

Results of radiation therapy in rectal cancer have shown gradual improvement, due to a better selection of cases, improved methods of technique, and more adequate dosage.

The additional advantages derived from the preoperative use of radium in selected cases cannot always be mathematically estimated, but we are convinced that a fair percentage of the successful surgical results obtained after radiation therapy could not have been obtained by surgery alone. Postoperative therapy, of definitely proved remaining disease, has been effectual in a number of instances.

The majority of cases treated by radiation therapy alone or in combination with colostomy have been advanced or inoperable. A large percentage of these were suitable only for minimal or moderately intensive therapy. Benefit of treatment in this latter group is demonstrated by an increased degree of comfort rather than by extension of life. Comparatively few patients who have reached the advanced stages live more than two years after coming under observation. However, practically all ambulatory cases were greatly relieved of distressing symptoms, which, in a fair percentage of cases, either completely disappeared for a time, or were reduced to the degree that the patient could follow a gainful occupation.

More striking results were obtained with cases suitable for intensive treatment. This is clearly demonstrated by a survey of our active files of patients who have survived the two year period. There are 27 patients alive who have been under observation for more than two years treated by radiation therapy alone or radiation therapy and colostomy. Twenty of these are considered to be clinically free of rectal cancer. Fifteen have been followed personally and examined within two months while the conclusion that the other 5 are free of disease is drawn from recent reports of attending physicians or patients themselves. The period of time since treatment in this group of 20 cases is as follows: 4 are over two years, 3 over three years, 7 over four years, and 6 have remained free of disease over the five year period. Twenty of these patients were deemed operable while the remaining 10 were thought unsuitable for surgery. A colostomy was constructed in 8 instances, while 12 patients still retain a normal, or practically normal terminal intestinal tract.

FIBROMA OF THE COLON:

REPORT OF A CASE

G. W. Crile, M.D. and J. C. McClintock, M.D.

CLEVELAND, OHIO

A HOUSEWIFE, aged forty-three years, was admitted to the Cleveland Clinic Hospital on October 5, 1931. Her complaint was that she had fibroids and her illness had begun with a pregnancy which had terminated three months before. During the pregnancy she had been told that she had a very large uterine fibroid. The delivery had been normal and the infant had been nursed for six weeks. The menstrual flow had just reappeared, apparently normally, but the patient felt she had best present herself for a thorough examination. Menstruation had begun at sixteen, always had been irregular and associated with cramps and the passage of clots, until after her marriage. For six years the periods had been regular. There never had been any unusual flow or intermenstrual bleeding. There had been one other normal pregnancy terminated in 1925.

The patient said that she had a good appetite and denied all symptoms of indigestion. There had been no vomiting, no jaundice, no bloody or tarry stools, no diarrhea or constipation. The only significant fact brought out by the history was that there had been some urinary frequency and nocturia which required that she get up once or twice each night.

On physical examination, a large moveable tumor mass, slightly tender, hard and multilobular was found in the abdomen. This spherical tumor was in the right upper quadrant and was about 10 cm. in diameter. There was no rigidity, no free fluid and the liver and spleen seemed normal. An old laceration of the perineum and a laceration of the cervix was present and a tumor was palpable high on the fundus of the uterus. The laboratory examinations revealed no abnormalities. The diagnosis was wandering fibroid, lacerated perineum and lacerated cervix. Immediate operation was advised.

Dr. Crile opened the abdomen through a right paramedian incision. The tumor mass was drawn into the wound and found to be adherent to and surrounded on half of its circumference by the ascending colon. The major part of the blood supply of the tumor was taken from that portion of the colon nearest the cecum. There was no connection with the uterus although there was a small fibroid on the fundus. The tumor was excised but it was necessary to resect the ascending colon for about 8 inches, and because the small bowel was involved the first portion of the jejunum also was resected for about 3 inches, together with a portion of the mesentery of the small bowel. The bowel was closed in both places by end-to-end anastomosis and the defect in the mesentery was repaired. An ileostomy then was done and the abdomen closed without drainage. The pathologic diagnosis was fibroma of the intestine with marked collagen formation. The specimen weighed 1265 gm.

The patient received the usual supportive treatment consisting of transfusion, intravenous and subcutaneous fluids, gastric lavage and hot stupes to the abdomen with the necessary sedatives, but in spite of these she continued to lose ground and died on the seventh day following operation. Chemical tests on the blood made on the day before death showed normal values for carbon dioxide, urea, sugar and chlorides.

At necropsy the ends of the anastomosis of the colon were found gangrenous and separated and surrounded by a large abscess which was extending downward retroperitoneally toward the inferior pole of the right kidney. There was peritonitis, chiefly on the right side. The anastomosis of the ileum was intact. There were no other tumors.

Fibromata of the intestinal tract are rare. Clifton and Landry summarized the literature up to 1927 and found only 45 cases of proved fibroma. The statistical results of their search show that only 32 cases of this group were of pure fibroma, the others were of fibromyxoma, fibroadenoma and fibromyoma. The tumors were found in the small bowel in 25 cases;

18 of these were in the ileum; in 13 cases the colon was involved and 7 cases were designated as enteric. There were 25 females and 20 males in the group and the average age was 39.3 years. The size of the tumors varied from that of a pea to a tumor the size of an infant's head.

Fig. 1. Fibroma of colon removed at operation.

The pathologic picture seen in these tumors varies somewhat, depending on whether they are of the hard or soft variety. The hard type is composed chiefly of bundles of collagen fibrils with relatively few spindle-shaped cells. Blood vessels are few. They usually are encapsulated and grow slowly. Degenerative changes may take place in the interior of the tumor. Soft fibromata have fewer collagen fibers, the meshes of the tissue are quite loose and often are filled with mucoid material. Connective tissue cells and blood vessels are more abundant.

The symptoms caused by these tumors are varied. There may be no complaints at all, as in our case, or the tumors may be discovered at autopsy. Frequently the symptoms are those of invagination with colic, nausea, vomiting and usually a palpable tumor mass, all of which may subside spontaneously. Alternate diarrhea and constipation with or without bloody or tarry stools and mucus may be present. There may be small, large or repeated hemorrhages from the tumors, leading to secondary anemia. The pain, if it has been present in recurrent attacks, usually starts and remains in the same place. The patient may or may not lose weight. Medical advice usually is sought because of the symptoms either of obstruction or of intussusception. Not uncommonly these symptoms have recurred several times.

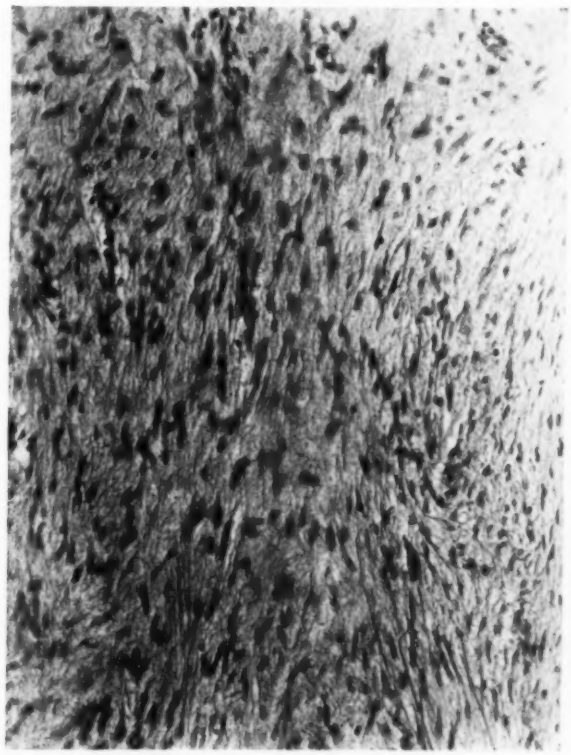

Fig. 2. Section of fibroma of colon (× 150).

As a rule, the diagnosis is not made preoperatively. In 75 per cent of the cases studied by Clifton and Landry intussusception was found at operation, which represents fairly accurately the usual

diagnostic reason for opening the abdomen in cases where benign tumors are really the basic cause of trouble. The history of recurrent attacks of localized colic or pain with nausea and vomiting should suggest the possibility of benign intestinal tumors. It is to be remembered that in adults the most frequent cause for intussusception is the presence of a tumor, and further, that it is not the rule for malignant growths to cause this condition. Roentgenographic examination may be helpful in localizing an obstructive lesion. Because of the nature of the symptoms, colitis, hemorrhagic colitis and even dysentery have been diagnosed where tumors were really the cause.

The treatment is operative removal with resection of the bowel if necessary. The mortality has been about 27 per cent but the non-surgical mortality has been 100 per cent.

Brief mention may be made of the other forms of benign intestinal tumors. King in an analysis in 1917 found only 119 cases of benign tumors in the literature. In reviewing the statistics from the Mayo Clinic he found only 14 cases of benign intestinal tumors in 44,654 laparotomies. These other forms include in the order of their frequency: myoma, lipoma, adenoma, fibroma and angioma. Neurofibroma, teratoblastoma, and rhabdomyoma are listed among the rarer forms. In general it may be said that benign tumors are more frequent in the large bowel, and occur more commonly in women. Patients of almost any age may be affected, although the incidence of these lesions is highest in the fourth and fifth decades.

The symptoms fall into two classes: irritative, with vague digestive disturbances; or obstructive, with pain, nausea and vomiting, bloody or tarry stools and alternate constipation and diarrhea. Rectal tumors may be associated with tenesmus and a feeling that there is a foreign body in the rectum, and may be confused with carcinoma. The diagnosis, as in cases of intestinal fibroma, usually is made at operation or at autopsy. Operative removal is the treatment indicated in all cases.

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HEMIPYONEPHROSIS IN INFANTS AND CHILDREN*

TREATMENT BY HEMINEPHRECTOMY

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HEMIPYONEPHROSIS (pyonephrosis of half of a reduplicated or double kidney) is not uncommon although it is infrequently diagnosed correctly. Fortunately, the local pathology often permits conservative resection of the kidney with preservation of the undiseased portion. Attention is here directed to the condition in juveniles as exemplified in 5* infants and children observed and treated by the writer. All except one, a girl of five years, were less than thirty months of age. All were subjected to urological examination because of so-called chronic pyelitis. In 4 cases the diagnosis was made preoperatively; in the fifth case it was missed because of failure to compare the urograms. In 3 instances (infants) uretero-heminephrectomy was successfully performed with cure of the urinary infection; in 2, nephrectomy was carried out.

ETIOLOGY AND ANATOMY

Renal reduplication or so-called double kidney is the commonest major renal anomaly and in a series of 26,480 autopsies at Bellevue, Babies', New York Nursery and Child's and Willard Parker Hospitals studied by the writer, it occurred in 136 cases or 0.5 per cent. Oddly, it was complete bilateral in only 2 cases. Reduplication occurs slightly more often on the left side and is twice as frequent in females as in males; all of our patients were girls. The anomaly results from developmental variations of the ureteral bud (Fig. 1) before it enters the nephrogenic blastema, either a partial splitting (70 per cent) with one ureteral orifice (Fig. 2, C) or a complete reduplication (30 per cent) with two distinct ureteral orifices (Fig. 12, B). With rarest exception there are as many pelves as branching ureteral stalks.

Clinical observations indicate that anomalous organs are more prone to disease than are the normal. This is particularly true in the kidney where congenital malposition, ureteral stricture (Figs. 12, 13, Case IV), ureteral ectopy (Figs. 4, 9, Cases II, III), or other lesions causing urinary stasis commonly accompany embryologic deviations. Urinary stasis always predisposes to infection. With the advent of infection, renal destruction, calculus formation and perirenal lesions are frequently noted. In a young adult male we have recently found tuberculous hemipyonephrosis with two large stones in the diseased pelvis.

PATHOLOGY

Although renal reduplication is usually suggested by embryologic markings on the kidney surface (a circumferential groove or indentation, slight bulging or marked difference in size of the two segmental units) in many instances the organs appear normal or but slightly elongated. Usually the blood supply is dual; this renders resection easier than when there is but one main pedicle. Compression of the various vessels indicates by parenchymal anemia (arterial) or cyanosis (venous) the areas thereby supplied; in other words, which vessels to cut.

The local pathology of pyonephrosis of half of a double kidney does not differ from that in a normally formed organ; the parenchyma about the uninvolved pelvis

† I have recently had a sixth case which should be added to this series. A girl of three years with chronic pyuria for two and one-half years showed a condition identical with that in Case II, Figures 5 and 6.

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is usually normal although it may be small in amount. On the other hand, a large amount of sound parenchyma may surround a small fetal type of pelvis (Case IV, Fig. 12). The pyonephrotic renal portion may be widely ulcerated, cavernous, thin walled, scarred or lobulated. With long-standing infection, perirenal fibrolipomatosis may be marked. The diseased ureter is enlarged, thickened and surrounded by indurated and scarred areolar tissue.

SYMPTOMS

The symptoms are those of pyonephrosis and in children regularly lead to the diagnosis of chronic pyelitis. The urine may contain more than a fourth pus by volume. Fever may be intermittent, remittent, low grade, or absent. With acute ureteral obstruction however, signs and symptoms of urinary sepsis are at once manifest; loin pain indicates the involved side. With free continuous drainage, fever is slight or negligible. Pain in the loin or costovertebral angle is common; renal enlargement may be elicited. Disturbances of urination: frequency, dysuria, urgency, burning, etc., are due to secondary vesical infection and inflammation. Gastrointestinal symptoms: anorexia, nausea, vomiting and the like, are especially common in urinary infection in children; there may be loss of weight or failure to gain.

DIAGNOSIS

The diagnosis is easily made by complete urologic examination which should always be carried out in children when pyuria resists intensive medical therapy for one month. The technical examination is identical with that in adults except that in about half of the juvenile cases, general anesthesia must be employed. With incomplete ureteral reduplication but one ureteral orifice will be found; pyelographic injection of one ureter branch will often reflux into the other division. With complete ureteral reduplication, one or both of the orifices may be ectopic. In 2 of our cases (II, III) the ureter from the pyonephrotic renal segment opened into the urethra. As is well recognized, the ureter from the uppermost pelvis empties lowermost in the urinary tract (Figs. 1, 9).

Ureteral catheterization and dye function estimation (indigocarmine is our choice) at once suggests the site and severity of the lesion. Pyelography confirms it. The pyonephrotic pelvis is recognized; the adjacent normal pelvis is usually fetal or deformed in outline. Ureterography indicates the course of this channel as well as constrictions (Fig. 12), angulations and other abnormalities. More recently, intravenous urography has been used with considerable success and in 2 of our cases (II, V) helped to establish the diagnosis.

TREATMENT

When the uninvolved renal segment is of good function, renal resection with excision of as much of the diseased ureter as possible is the treatment. Preoperative urograms will indicate the approximate separation of the two pelves (Figs. 8, 12, B). In some instances the diseased and the normal calyces are closely approximated or may interdigitate and leave no clear band of parenchyma between. Here resection may be technically unfeasible or impossible.

Following renal delivery, a study of the organ may reveal embryologic markings indicative of segmental division. A dual blood supply renders identification of the two renal units easy. When the parenchymal and pedicle appearance is normal, one must perform resection chiefly by pyelographic guidance. In children, pedicle compression between the second and third fingers is a simple method of rendering the renal field bloodless. In 2 cases, pedicle compression by a soft rubber tourniquet was effectual.

The kidney is cut across with attention to incise well into normal tissue in order that all badly infected parenchyma and pelvis may be removed. Any incised calyx of the remaining renal stump should be closed by one or two layers of sutures. Although a V excision is easiest to suture,

in many instances the kidney must be transversely severed. The method of renal suture used by the writer is shown in Figure 9 Pieces of fat are placed under the suture line before final tying. The kidney is replaced high in the loin where it is suspended by a hammock formed by suturing the posterior peritoneum to the quadratus lumborum muscle (Deming method). But two or three stitches of No. 00 twenty day chromic gut are necessary. The loin wound is closed with a cigarette drain. In 2 of our cases the wound healed by primary union without urinary leakage. In the other case, leakage occurred for four days when it spontaneously ceased and prompt loin healing followed. In all, the postoperative febrile reaction was meager.

When the patient is extremely ill or the parenchyma about the more normal pelvis is scant or diseased, nephrectomy is indicated. Both of these conditions existed in Case II. When tuberculous renal infection exists, total rather than partial nephrectomy should always be employed. In some instances nephrectomy is indicated by conditions which render renal resection technically impossible.

Renal resection is always undertaken with full recognition that postoperative infection or hemorrhage may necessitate emergency secondary nephrectomy. This has been required in a number of reported cases in adults.

CASE REPORTS

Case I. J. M., female, aged five years, was admitted to the Children's Medical Service of Bellevue Hospital March 10, 1926 with fever, gastrointestinal upset, a mild urinary frequency and marked pyuria. A diagnosis of pyelitis was made and alkaline therapy instituted.

Physical examination revealed a frail, anemic girl with a slightly enlarged and somewhat tender right kidney. Physical findings were otherwise negative.

Laboratory Examination: Urinalysis; cloudy; acid; sp. gr. 1.016; albumin ++; sugar 0; innumerable pus cells; culture B. coli. Blood chemistry: Non-protein-nitrogen was 32 mg. per 100 c.c. of blood; creatinin 1.1 mg. Phenolsulphonphthalein output (intramuscular) was 35 per cent in two hours. A plain urinary tract roentgenogram was negative for calculi and bony deformities.

Because the patient failed to improve under medical therapy the writer was requested to perform a urological examination. This was done April 1, 1926 and showed the following:

Urological Examination: Cystoscopy under open drop anesthesia; No. 15 F. double catheterizing instrument was passed without difficulty. The bladder urine was purulent; the bladder picture was that of generalized cystitis most marked about the right ureteral orifice. Both ureters were catheterized easily, a clear sparkling urine returning from the left side; a watery purulent return was obtained from the right side. Indigocarmine intravenously appeared in deep concentration from the left side in seven minutes; only a faint trace appeared from the right side in twenty minutes. A right pyelogram was made (Fig. 2 A). The ureter specimens showed the following:

	Urea	W.B.C.	Bacteria
Left.....	6 gm. per L.	1–2 H.P.F.	0
Right.....	0.25 gm. per L.	++++	B. coli

Nephrectomy for pyonephrosis was advised. This treatment was thought too radical by the attending pediatricians who requested a re-examination which showed the following:

Re-examination: April 18, 1926. Open drop anesthesia. Urine from right and left ureters clear and sparkling; indigocarmine intravenously returned from each side in deep concentration in six minutes. A pyelogram was made (Fig. 2 B).

It was then requested by the pediatric staff that pelvic lavage be performed a few times. Against our better judgment this was done twice but served only to upset the child who developed a higher temperature (102–104°F.) with evident urinary sepsis. May 5, nephrectomy was performed with uneventful recovery and ultimate cure of the urinary infection.

For some inexplicable reason, the two sets of preoperative urograms were not compared. Had they been, the condition found at operation: pyonephrosis of the lower half of a double kidney with a small but normal upper half,

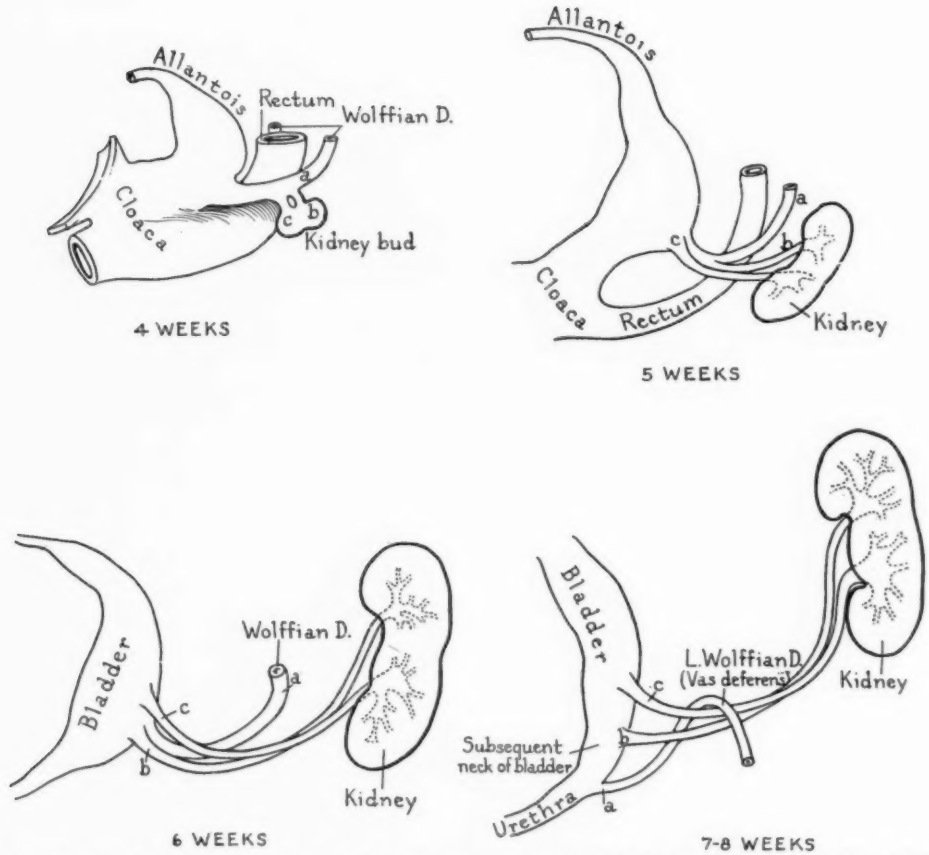


FIG. 1. Schema of embryology of ureteropelvic reduplication (double kidney). (After Kelly and Burnam.)

A B C

FIG. 2. Case 1.

A. Initial right pyelogram showing pyonephrotic lower pelvis.
B. Second right pyelogram showing small upper right pelvis.
C. Composite of A and B. At operation, ureteral branch to lower diseased pelvis was partially stenosed.

should have been diagnosed preoperatively. The ureter bifurcated about 5 cm. below the respective pelves; the branch to the lower

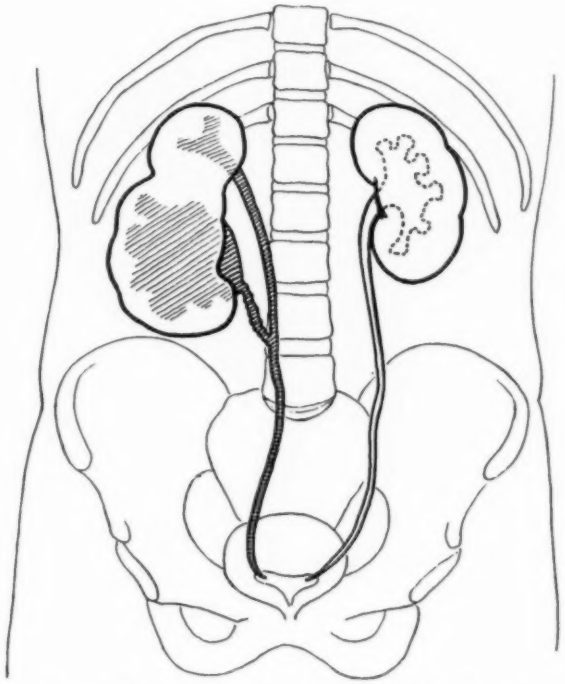


Fig. 3. Schema of operative findings in Case I.

pelvis was strictured just below the pelvis (Figs. 2 C, 3). Had the condition been recognized preoperatively, resection of the lower ureterorenal segment could easily have been performed with the probable conservation of a generous portion of ably functioning parenchyma.

Case II. D. C., female, aged eighteen months, on December 13, 1931 was admitted to the Children's Medical Division of Bellevue Hospital with a history of "kidney trouble" (pyuria) for one year. Beginning two months before admission there was swelling of left leg and back of the neck. On hospital admission there was a rash on the body and feet (impetigo and scabies).

Past History: Pneumonia at seven months after which the pyuria started. She had measles at eight months and pneumonia again at ten months. She had twice been hospitalized in other institutions.

Physical Examination: Lungs, bronchitis. There was a movable mass in the left subcostal region which felt like kidney rather than spleen. The temperature was normal.

Urological Examination: Urinalysis: purulent; acid; sp. gr. 1.016; albumin +++; sugar 0; culture and smears B. coli and Staphylococcus aureus.

Blood chemistry revealed: Non-protein-nitrogen 31 mg. per 100 c.c. of blood; creatinin 1.2 mg.; W.B.C. 7200; polymorphonuclears 50 per cent.

Fig. 4. Cystogram in Case II showing ectopic ureteral opening of dilated tortuous left ureter to upper pyonephrotic renal segment. Normal ureter from lower pelvis opened normally in bladder. Findings here closely resembled those in Case III (Fig. 9).

X-ray Examination: Plain urinary tract roentgengrams were normal.

December 13, 1932. Cystograms showed reflux up a dilated convoluted ureter (Fig. 4) which opened into the left posterior urethra.

Cystoscopy December 14, 1931. Open drop anesthesia. Bladder urine exceedingly purulent. Generalized cystitis most marked over trigone. Both ureters catheterized easily; urine from each appeared normal. In the posterior urethra on the left side was a third urethral opening discharging huge amounts of purulent urine. This outflow was increased by pressure over the upper left renal pole. I could not catheterize this ureter. Indigocarmine intravenously appeared in deep concentration from the left ureter (normally situated; to lower renal pelvis) in five minutes, the right catheter did not function.

Intravenous urography December 15, 1931 (20 c.c. of 40 per cent skiodan) showed double right pelvis with two ureters (but one opening

was seen in the bladder). On the left there was renal reduplication (Fig. 5) with pyonephrosis of the upper half of the kidney (Fig. 6).

Fig. 5. Intravenous urogram, Case II. A normal appearing right pelvis and left lower are noted; left upper pelvis is greatly dilated although faintly outlined.

December 20, 1931. Elevation of temperature to 103°F. Child sick and drowsy. Irritable. Losing weight.

December 21, 1931. A further attempt to catheterize the aberrant ureteral orifice was fruitless. In view of the findings and the acute illness of the child, immediate operation was advised.

December 22, 1931. A transfusion of 300 c.c. of whole blood was given.

Operation. December 23, 1931. Left nephrectomy was performed under gas-oxygen-ether anesthesia. We found a double kidney having an enormous pyonephrotic upper pelvis and a small compressed but otherwise normal lower pelvis (Fig. 6). Because of the extent of the pyonephrosis and the illness of the child, hasty renal removal was deemed wisest. The ureters were removed downward for about 3 inches.

Postoperatively, numerous hypodermoclyses of 5 per cent glucose in physiologic saline solutions were given. Uneventful recovery ensued with discharge January 17, 1932 at which time the urine was microscopically normal.

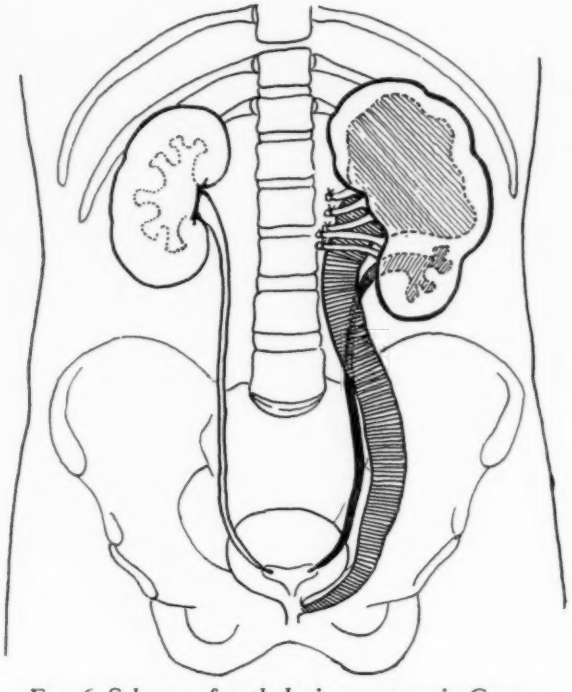


Fig. 6. Schema of pathologic anatomy in Case II.

Pathological Report: Kidney measures 6 × 4 inches and feels soft, especially the upper four-fifths. The upper pelvis is large and bulging and its ureter measures ½ inch (Fig. 6). A small normal ureter passes from the lower pelvis. There is a natural line of demarcation between the apparently normal lower fifth and the upper part of the kidney. The artery to the kidney enters with the upper ureter; the veins are divided between the abnormal and normal ureter. On opening the kidney, the upper pelvis occupies four-fifths of the organ and is surrounded by cortex 5 mm. thick. The lower pelvis is small but not inflamed.

Microscopic report: Pyonephrosis.

Case III has been reported in detail elsewhere[1]; the salient features are summarized here.

Case III. E. M., female, aged five months, was admitted to Babies' Hospital September 18, 1929 with a history of persistent pyuria and intermittent fever since birth. She had bronchitis at four and a half months with a temperature of 105°F.; the urine was milky and one-third pus by volume. After one week, the patient left the hospital but returned in

another week with fever, pyuria and gastro-intestinal upset.

Physical Examination: The patient was a sick and anemic infant. The left kidney was palpable. Diagnosis: pharyngitis, otitis, gingivitis, pyuria.

Fig. 7. "Cystogram" in Case III. It was found urethral catheter had been passed into ureter through an ectopic urethral opening.

Fig. 8. Pyelogram in Case III. Left upper pelvis catheterized through ectopic urethral orifice. Broad band of parenchyma separating upper and lower left pelvis at once suggests feasibility of renal resection which, in this case, was performed at the age of six months.

Urological Examination: Laboratory: Urinalysis; cloudy; acid; sp. gr. 1.008; albumin +++; sugar 0; pus ++++; B. coli. Non-protein-nitrogen was 43 mg. per 100 c.c. of blood; urea nitrogen 23 mg.; chlorides 575 mg. Two hour intramuscular phenolsulphonphthalein was: first hour 38 per cent; second hour 37.5 per cent. A plain urinary tract roentgenogram was normal. Cystogram (Fig. 7) shows the ureteral orifice from the pyonephrotic upper left renal pelvis opens into the urethra. The urethral catheter passed directly into the ureter.

Cystoscopy November 7, 1929. Open drop anesthesia. Bladder urine was cloudy. Trigonitis was noted. Both ureters were catheterized easily. The right catheter did not function; urine from the left was cloudy and pale. A bilateral pyelogram showed apparently normal outlines. The ectopic orifice could not be found at this time.

November 12, 1929: Urethroscopic examination showed an ectopic left ureteral orifice opening on the floor of the mid-urethra. A No. 5 F. catheter was passed up this ureter and withdrew 20 c.c. of purulent urine. Both normally opening ureters were catheterized. Indigocarmine intravenously appeared in deep concentration in ten minutes from the right ureter and lower left pelvis; after fifteen minutes there was a faint trace from the left upper pelvis. Specimen examination revealed the following:

	Indigo-carmine	Urea gm. per l.	Pus Cells	Cul-ture
Right kidney.....	Deep	5	Few	B. coli
Left lower pelvis..	Deep	6	Few	B. coli
Left upper pelvis..	Trace	1	++++	B. coli

All three catheters were injected with small amounts of 12 per cent sodium iodide and a pyelogram made (Fig. 8). A band of paren-

chyma 1 cm. wide separated the normal lower from the pyonephrotic upper left pelvis. This finding indicated at once the feasibility of attempting heminephrectomy with removal of as much of the left ureter as possible.

Pathologically the removed specimen showed chronic ureteritis and chronic suppurative interstitial nephritis.

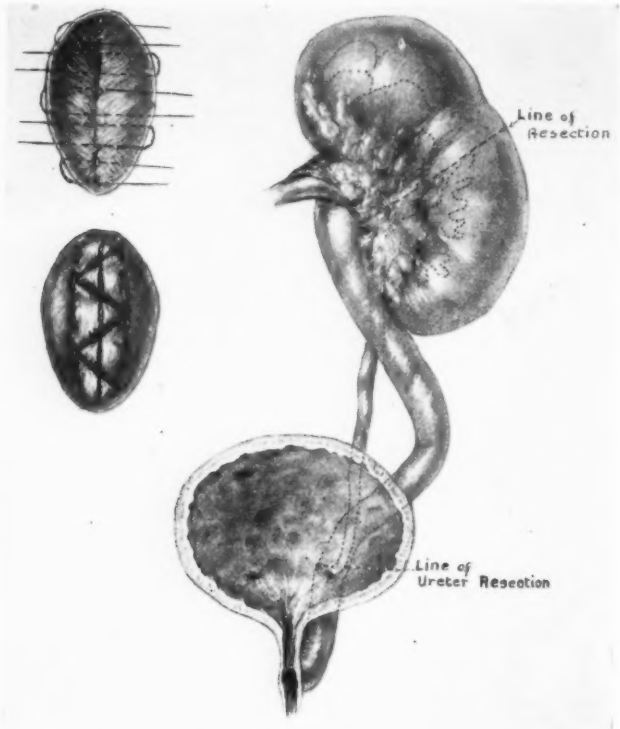


Fig. 9. Schema of findings in Case III. Method of renal closure is indicated. A small pad of fat is placed along closure line before tying over ligature ends.

Operation (November 16, 1929). Open drop ether anesthesia. Kidney loin incision carried well forward over pelvic brim. The diseased ureter was dissected free to about 1 inch from its urethral insertion, cut between ligatures and cauterized. Kidney delivered. The diseased upper half of the organ was not embryologically demarcated and did not have a separate blood supply. The renal pedicle passed more to the lower half of the kidney. A small soft rubber tourniquet was placed about the pedicle and the upper half of the organ resected transversely (Fig. 9). As the original resection incision passed through the lower portion of the upper diseased pelvis, it was necessary to pare the kidney parenchyma down until all upper pelvic mucosa and a small amount of apparently healthy tissue had been removed. Upper kidney half and ureter were removed en masse (Fig. 10). Kidney closure suture and surgical pathology are shown in Figure 9. Cigarette drain and usual loin closure.

Postoperatively, the temperature rose to 103.6°F. but was normal in forty-eight hours and remained so. Fluids were forced by mouth and hypodermoclysis (3 per cent glucose in saline solution). Patient was discharged three weeks after operation. Four weeks after operation the urine was normal except for an occasional pus cell. Six months postoperatively specimen contained only a rare leucocyte. At this time a great increase in weight was noted. There were no urinary symptoms. Phenolsulphonphthalein output 80 per cent in two hours. A pyelogram made one year postoperatively (Fig. 11) shows an undistorted remaining left renal segment.

Case IV has been reported in full elsewhere;[1] it is reported here with some abbreviation.

Case IV. J. M., female, aged five weeks, was admitted to the Children's Medical Service of Bellevue Hospital June 28, 1928, with a history of pyuria since birth. Physical examination revealed an acute upper respira-

tory infection with bilateral otitis media. Both kidneys were palpable; the left was larger than the right. The urine was heavily laden with

Fig. 10. Ureteroheminephrectomy specimen in Case III.

pus and on culture B. coli, Staphylococcus aureus and hemolytic streptococci were found. The baby was extremely ill, became jaundiced, required bilateral myringotomy as well as drainage of a cervical abscess. Two months after admission the child was still febrile and was rapidly losing. Because of the persistent pyuria we were asked to see her and a complete urological examination was begun without great delay.

A plain roentgenogram of the urinary tract was normal. Cystoscopy under open drop anesthesia showed cloudy urine, marked cystitis, two ureteral orifices on the right side and pyelography revealed an uninfected complete right upper tract reduplication with normal function. On the left the ureterovesical junction was extremely tight to a No. 4 F. catheter, the urine showed colon bacillus infection, was grossly purulent, renal function was almost nil and urography disclosed a large hydroureter and hydronephrosis obviously due to ureterovesical junction stricture (Fig. 12).

Because of the tender age and debilitated condition of the patient and in an attempt at conservatism, the establishment of freer left ureteral drainage by dilatation was decided upon. Over a period of eighteen months dilatation of the ureterovesical stricture was carried out. At first with great difficulty could

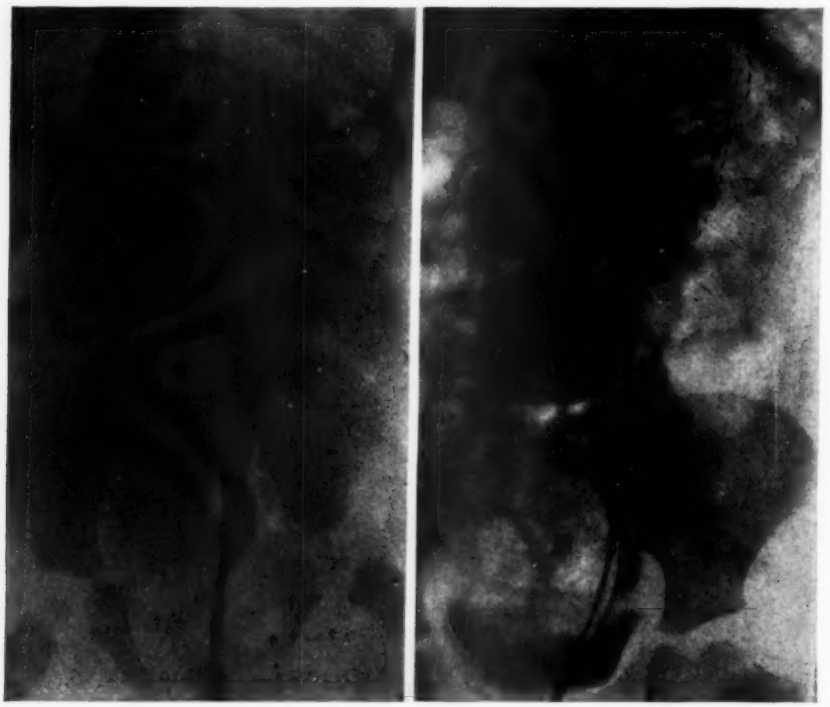
Fig. 11. Case III. Pyelogram of remaining left renal segment one year postoperatively. Organ is well placed with adequate drainage. Renal function was normal at this time.

one No. 4 F. catheter be passed. Later two catheters were passed side by side and ultimately four were so employed. This was done ten times; thrice without an anesthetic. This treatment resulted in marked diminution of infection and coincident improvement of renal function so that after a year the indigocarmine output of the left kidney nearly equalled that of the right. During this time, however, there were attacks of so-called "acute pyelitis," usually in association with a respiratory or other infection. During this time, also, a mild right renal infection developed.

The blood non-protein-nitrogen ranged between 25.8 and 33.5 mg. per 100 c.c. Blood creatinin, uric acid, plasma protein phosphates, chlorides, cholesterol and calcium were also repeatedly within normal limits. Two-hour phenolsulphonphthalein tests varied from 34 to 47 per cent. The highest temperature was 105.2°F. Albuminuria, pyuria and bacteriuria were always found.

Because of the anomalous right reduplication and the character of the left pyelogram (Fig. 6)

left reduplication was suspected from the first but not until the child was twenty-seven months old was the other left orifice located of particular interest. The two segments of the reduplicated organ were sharply demarcated, not only by a groove but by a marked difference



A B

FIG. 12. Urogram in Case IV.

A. At the age of twelve months with three No. 4 F. catheters in site for dilatation of congenital ureterovesical junction stricture. Bilateral renal reduplication existed.

B. Double left injection showing a small fetal type upper pelvis and hydronephrotic lower pelvis. Lines of ureteroheminephrectomy resection at age of twenty-eight months are indicated. Small upper pelvis was surrounded by a large segment of solid parenchyma.

behind the ureteric mound in swollen mucosa. Catheterization of the left upper pelvis returned a clear sparkling urine containing 4 gm. of urea per liter; indigocarmine functional estimation normal; pyelography showed a small fetal pelvis. The ureter was normal (Fig. 13). In view of these findings and the persistence of the infection of the lower left pelvis, ureteroheminephrectomy was decided upon.

Operation: Left ureteroheminephrectomy, October 6, 1930. Patient twenty-eight months of age. Gas-oxygen anesthesia. Through a left loin incision the kidney was delivered, the ureter freed to about 2 cm. from the bladder, here ligated, cut and removed en masse with the resected lower half of the kidney (Fig. 14). The same resection technique was employed as described in Case I. Usual loin closure with cigarette drainage.

The surgical anatomy and pathology were in gross appearance. Surrounding the small fetal upper pelvis was a large amount of normal renal parenchyma; it constituted two-thirds of the entire parenchymatous mass. The parenchyma encasing the hydronephrotic lower pole was pale, flabby, soft and somewhat wrinkled. Each segment had its own blood supply; that to the lower half was cut.

Postoperative Convalescence: Urinary drainage through loin for first twenty-four hours. On the sixth day a moderate sized anterior wound abscess required drainage. Wound repair and convalescence were normal thereafter. The patient was discharged healed in three weeks. One year postoperatively the urine is normal. Catheterization and pyelography of the remaining upper left segment shows no infection, normal function and an outline similar to that noted preoperatively.

CASE V. G. N., female, aged twenty-two months, on January 20, 1932 was referred by

Dr. Curlin C. Craven for urological examination because of pyuria of seven months' duration. The pyuria onset followed acute tonsil-

Fig. 13. Ureteroheminephrectomy specimen in Case IV.

lectomy. There had been no gain in weight during this seven month period. No gastrointestinal upsets or disturbances of urination had been noted. Periodic fever had occurred.

Physical examination revealed a well-nourished child. The right kidney was palpable but not tender. The liver was felt at the costal margin.

Urological Examination: Urinalysis: purulent; acid; sp. gr. 1.014; albumin ++; sugar 0; B. coli. Non-protein-nitrogen was 40.8 mg. per 100 c.c. of blood. Two hour intramuscular phenolsulphonphthalein test showed: first hour 12½ per cent; second hour 12½ per cent. Plain urinary tract roentgenogram was normal as was the cystogram.

Cystoscopy: No anesthesia. Bladder urine was purulent and trigonitis existed. Left ureter was catheterized easily with a normal return. On the right side the catheter was stopped 4.5–5 cm. up; it would not pass beyond this point. No urinary return was obtained from this side. Indigocarmine intravenously returned in deep concentration from the left side in five minutes; none returned from the right kidney. Bilateral pyelogram showed a normal left upper tract; on the right side, the media refluxed to the bladder.

January 20, 1932: Intravenous urography showed a normal left ureter and pelvis with

Fig. 14. Intravenous urogram one hour after dye injection in Case V. Left pelvis (picture reversed) is normal. Lower right pelvis is distorted somewhat; course of its ureter to bladder is easily followed. Hydropyonephrotic upper segment is darkly outlined although course of ureter is indistinct. Successful ureteroheminephrectomy at the age of twenty-two months.

a small slightly distorted lower right pelvis. The upper right pelvis was faintly outlined only in the one hour film (Fig. 15). The ureter was not made out. Diagnosis: Right upper hemipyonephrosis. The termination of the right ureter is in doubt. Advise ureteroheminephrectomy.

Ureterobeminepbrectomy, January 26, 1932: Gas-oxygen-ether anesthesia. The right kidney was exposed and delivered. The organ was unusually long; the upper three-fourths were soft, pyonephrotic and sharply demarcated from the lower solid segment. The vascular supplies were separate. (Fig. 16.) Following cutting and ligation of the vessels to the pyonephrotic upper renal segment, the diseased ureter (dilated and indurated) was separated downward for about 10 cm. and divided. With compression between the second and

third fingers (Fig. 16) of the vascular supply of the remaining good renal segment, the organ was resected, closed and the remaining portion

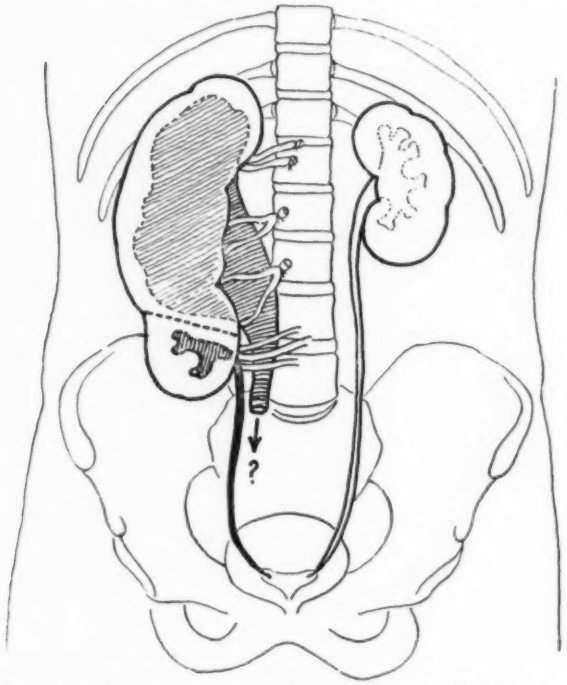


Fig. 15. Schema of pathologic anatomy in Case v. Termination of diseased ureter from resected left upper pole was never determined, either with or without chromocystoscopy.

suspended. The wound was closed with two cigarette drains.

Recovery was uneventful followed by discharge home on the twelfth day. One month later the urine was normal and sterile. Intravenous urographic check up showed an actively functioning remaining renal segment; the pelvis showed a marked postoperative distortion. Renal function check-up one month postoperatively revealed: Non-protein-nitrogen 33.8 mg. per 100 c.c. of blood; phenolsulphonphthalein first hour 25 per cent; second hour 10 per cent. Still greater improvement may be expected.

SUMMARY

Five cases of hemipyonephrosis in very young children are reported. Being anomalous, reduplicated kidneys are more prone to disease than are normal organs. The condition illustrates another lesion which may cause persistent urinary infections in juveniles and because of pyuria, commonly leads to the diagnosis of "chronic pyelitis." The correct diagnosis of hemipyonephrosis is made by urologic examination. When half of the double kidney remains undiseased, and the operation is technically feasible and the condition of the patient permits, ureteroheminephrectomy is the treatment. With marked renal infection, especially acute, nephrectomy is often the wiser course. In the youngest patient of this series, ureteroheminephrectomy was successfully performed at the age of six months.

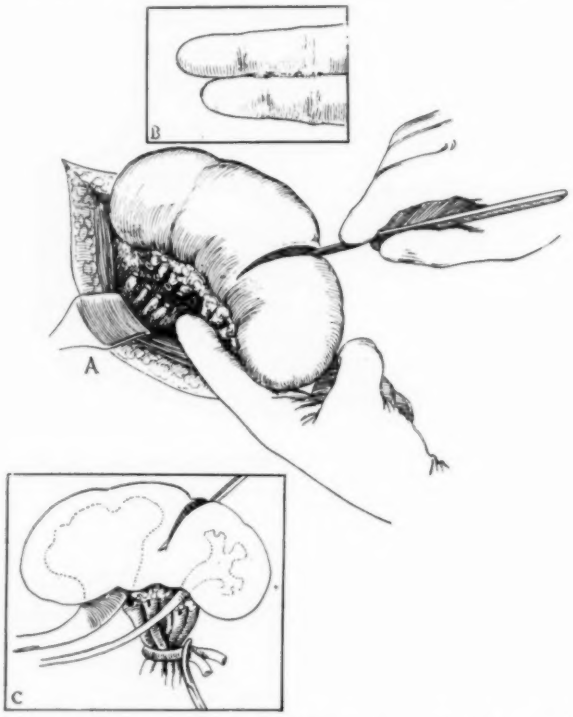


Fig. 16. Technique of pedicle compression in renal resection. A, B, with fingers, C with tourniquet.

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FOLLICULAR CELL CARCINOMA OF OVARY

WITH REPORT OF CASE*

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NEW YORK CITY

DESPITE the many works that have been published on the subject of epithelial tumors of the ovary, the histogenesis and classification of these tumors have continued to be a source of much confusion. The terms folliculoma, oöphoroma and granulosa cell tumor have been loosely applied to adenomata, carcinomata and other tumors which had in common only the fact that the formations present in the parenchyma of the tumor bore some resemblance morphologically to the structure of the follicles or ova.

In view of the widespread interest at the present in the discussion of the origin of these very rare tumors, I have thought it of value to publish the following case which has recently come under my own personal observation.

CASE HISTORY

Miss B. R., twenty-nine years old, was admitted to the New York Polyclinic Hospital on January 11, 1931, complaining of excessive menstrual bleeding during the past four months. Her general appearance was that of a healthy adult female, well nourished and of good color, not acutely ill nor suffering with acute pain.

She stated that her first menstruation was at the age of twelve and one-half years. The menses, which were of five days' duration, had been quite regular until three years ago, when she began to skip one or two months at a time. Finally she went nine months without menstruating, up to September 1, 1930. She then flowed for ten days, stopped, but after a few days had another ten-day period. She had been following this course for the last four months, up to the time of her admission to hospital. The menstrual discharge was of a dark color and had a very foul odor.

There was no history of pain. Bowels constipated. No indigestion. No palpitation nor shortness of breath; no edema of ankles. Abdomen soft; no tenderness. Liver, spleen and kidneys not palpable.

On rectal examination a mass the size of a grapefruit was felt in the left lower abdomen. Recto-abdominal examination revealed what appeared to be a large, hard, smooth uterus, reaching to the umbilicus. No vaginal examination was made, on account of an intact hymen.

Preoperative Diagnosis: Fibroma uteri.

Operation, January 12, 1931. A low median incision was made. The peritoneum was opened, and the following were found: Straw-colored fluid within the peritoneal cavity, a multilocular cyst of the left ovary, with small grapelike bodies between the folds. The entire mass was wedged in the pelvis and adherent. On separation of the adhesions, one of the cysts broke and bloody fluid escaped. The uterus was very small, normal to touch and appearance. Right tube and ovary normal. Stomach, duodenum and gall bladder normal to palpation. The fluid within the peritoneal cavity was mopped out with sponges, and the entire cystic mass on the left side, together with the tube, was removed between clamps. The stump was transfixed with plain catgut No. 2 and the raw surface covered over with the round and broad ligaments of the left side. The peritoneum was closed with plain catgut No. 2 and the lower angle brought in toward the symphysis pubis. The fascia was closed with interlocking chromic catgut No. 2; the skin, with four figure-of-eight dermal sutures followed by continuous black silk.

Postoperative Diagnosis: Multilocular cyst, possibly papillo-adenoma of the left ovary.

The patbological findings were as follows: The specimen (Figs. 1 and 2) consists of a large ovarian cyst about 10 cm. in diameter, and weighing 10 lbs., which is made up of many compartments, most of which are filled with a bloody serous material, and several of which

* From the New York Polyclinic Medical School and Hospital.

show old, degenerated blood contents. For the most part the interior of the cyst is of semi-fluid consistency. Embedded in the wall are a number of fragments of yellowish, lipoidal and cholesterin-like material which, in some areas, strongly suggest the appearance of a malignant tumor.

Microscopically, in the cyst is found an anaplastic, epithelial growth of more or less embryonal type, in which there is considerable mucinous material and edema. It is of low grade malignancy and contains a considerable amount of mucinous material in the connective tissue. It is difficult to determine the type of cell origin in this tumor, although it apparently is primary in the ovary and probably comes from some of the follicular granulosa cells.

Histological Diagnosis: Carcinoma of the ovary, Grade 1 plus (folliculoma malignum). Pseudo-mucinous multilocular cystoma of the ovary.

Fig. 1. Follicular cell carcinoma of ovary. Small, diffusely scattered cells are tumor cells. Follicular origin of cell is shown at A.

The patient made an uneventful recovery, and was discharged from hospital January 24, 1931. She subsequently received an *x*-ray cycle of ten treatments, covering 5 pelvic fields, 2 anterior and 2 posterior, of which each received 150 per cent S. A. D. equalling 1100 r. (international r. unit); and 1 vaginal field of 100 per cent S. A. D. equalling 750 r. Westinghouse constant potential machine used—factor 180 kv., 4 ma., 0.5 mm. copper, 1.0 mm. aluminum filtration used, 50 cm. distance. A marked erythema was obtained seven days after treatment.

January 2, 1932. Patient examined again. Has gained in weight; looks and feels well. Has not menstruated. Uterus small, anterior, freely movable. Both fornices free. She goes to business, and is the picture of health.

Fig. 2. Follicular cell carcinoma of ovary. Masses of darker staining cells are of follicular origin. Paler connective tissue is very edematous.

DISCUSSION

The first description of a type of ovarian cancer composed of epithelium showing a strong resemblance to the granulosa layer of the follicles was published by Rokitansky in 1855. Not again do we find a reference to the subject until 1888, when Acconci[1] published a similar case. In 1895 v. Kahlden[2] described an ovarian tumor in a young girl, which appeared microscopically to be composed of two kinds of elements, one part containing alveoli closely packed together, which the author regarded as primordial follicles, and the other part made up of epithelial strands anastomosing together, regarded by v. Kahlden[2] as cancerous structures, the result of a vigorous proliferation of the primordial follicles.

Gottschalk[3] in 1899 was the first to use the term folliculoma malignum ovarii, which he bestowed upon a tumor the structure of which resembled in some respects stroma of the ovary. He chose this name, on the ground that the tumor was developed from the wall of the primordial

follicle, and that it represented a new growth of both anatomical and clinical malignity.

Pick,[4] Ingier,[5] and others, for their part, regarded the follicular origin of this neoplasm as by no means demonstrated. Ewing,[6] however, inclines to believe that folliculoma malignum is a form of ovarian tumor in which the alveoli resemble thyroid structure in their early stages while the secretion of mucus is scanty.

In 1921 Aschner[7] was able to collect from the literature 24 cases of folliculoma, to which he added one of his own.

Geist,[8] writing in 1922, pointed out the confusion of the nomenclature that still prevailed, stating that tumors similar to the one he described had been termed adenoma of the graafian follicle, folliculoma malignum, carcinoma folliculoides, oöphoroma folliculare and folliculoma. v. Werdt[9] gave the name of granulosa cell tumor to a group of six tumors of similar type to the above-mentioned.

In most of the tumors of denominated folliculomata there have been cylindromatous changes into various types of neoplasms, chiefly carcinomata, and in only a few cases, such as those of Brenner,[10] v. Werdt,[9] Aschner,[7] Geist,[8] and Robinson,[11] has there actually been a formation of incomplete follicles such as would justify the name folliculoma.

In order to clarify the subject, v. Werdt[9] in 1914 made a study of 6 cases of ovarian tumor which represented a relatively high stage of differentiation and contained clear replicas of the normal epithelial structure of the fetal or ripe ovary. In some of these tumors very low stages of development of the germinal epithelium were found side by side with highly differentiated follicles, some of which even contained ova, while intermediate stages were lacking. v. Werdt thus had no doubt that he had demonstrated that the tumors were developed from the germinal epithelium.

Brenner[10] gave to his 3 cases the name oöphoroma folliculare. According to this writer, these tumors reproduced the normal structure of the ovum and were composed almost entirely of structures resembling graafian follicles.

On the other hand, the tumors of Aschner,[7] Neumann[12] and Ulesko-Stroganowa[13] had little in common with v. Werdt's[9] or Brenner's[10] cases, and should, it seems, be considered as carcinomata which, although presenting some unusual disposition of their elements, do not represent any special type of tumor.

According to Robinson,[11] who has recently made an outstanding contribution to the subject, based on a study of 4 new cases, the chief morphological differences between the granulosa cell cancer and other forms of carcinoma are (1) the uniformity of the proliferating epithelium, particularly during the early stages of the neoplastic development; (2) the absence of mitosis, with rare exceptions; (3) the absence of infiltrative and destructive tendencies; and (4) the spreading of the tumor by continuity and extension and not by way of the lymphatics or blood stream.

In all these tumors with which we are concerned there is a striking resemblance between the tumor and the type of cells of the granulosa layer of the ovarian follicles. These cells are characterized by:

(a) Their relatively small size

(b) Their large nuclei

(c) The striking capacity of these nuclei for taking stain

(d) The indefiniteness of the boundaries between them.

All these characteristics of the granulosa cell are also met in the elements of which the tumor is composed.

Microscopically, these tumors as a rule have the general appearance of an abnormally large ovary, frequently the size of a hen's egg, but capable of a range between that of a hazel nut and an infant's head. The surface is usually irregular, with protuberances of various size. The consistency may be of a hardness corresponding to the solid parts, but the cystic portions too are not infrequently of a hardness sufficient to cause the tumor to be mistaken, as

occurred in my own case, for a fibromyoma. The size of the tumor does not ordinarily affect its morphology, otherwise than that the larger ones tend to be cylindroid while the smaller ones are more frequently folliculoid in form. On the cut surfaces of the folliculoid type are seen elevations, and in many parts of the tumor cysts are observed, of a size ranging from that of a pea to a hen's egg.

The "folliculoma" is generally unilateral, Blau[14] having found only one bilateral case among 11 that he collected. Ingier[5] also reported a bilateral case. Of Blau's 11 cases, 9 were in women between the ages of fifty-four and seventy-three. Blau's own two cases included the unusual finding of the condition in a child of five, the other being in a woman of forty-five. Of Krompecher's[15] 6 cases, one was in a twelve year old girl.

According to Ewing,[6] the neoplasm is characterized by a honeycomb texture, small alveolar structure, embryonal character of its cells, and by slight malignancy. Metastases are absent. Ewing has also observed in 4 cases another type, of which Voigt's[16] and Ingier's[5] cases seem to be examples, in which the tumor is of moderate size, with alveoli small and compact, or larger with a free lumen. The cells here are unusually large and polygonal. The cytoplasm is clear and the borders of the cell are very distinct, differing in this respect from the first type.

Geist[8] observed the presence in his case of oval granular bodies within the cysts, which, as in my own case, were of pseudomucinous type. Goldberger[17] called attention to characteristic areas in which the cells group themselves into areolar forms like the spokes of a wheel, with the cells in the center undergoing degeneration. R. Meyer[18] also pointed out a tendency of the cells to become grouped in a concentric fashion and thus to form round or oval bodies or spherical structures.

The question of the origin of these tumors has been the subject of protracted debate. Are we, or are we not, warranted in concluding that they are derived from the epithelium of the graafian follicles? And again, are the folliculoid and the cylindroid types different tumors histogenetically, or are they to be regarded as merely different stages in the evolution of one and the same tumor?

There has been no unanimity in the answer to these questions.

The early disposition was to assume that tumors of this kind come from hypothetical cell rests of granulosa cell foci left from embryonal life. Thus Walthard,[19] in 1903, after making intensive studies on fetal ovaries, advanced the view that these tumors are derived from "islets" of granulosa cells which he described, and which, in his opinion, arise from the germinal epithelium which does not reach maturity, that is, does not become follicles. Within these islets he thought that primordial follicles and even ovarian ovules might form.

In this connection R. Meyer[18] says:

> The ripe follicular epithelium can scarcely be regarded as a tumor-forming tissue, for no proliferative phases have ever been observed in it; it stands or falls with the ripening of the ovum. There is no other type of cell whose existence is so slavishly dependent. It is therefore reasonable to regard the clumps of primordial granulosa which were retained in the stroma of the ovary as the genetic source of folliculoid and cylindrical cancer of the ovary.

Blau[14] takes the view that all tumors called folliculomata have been wrongly named, because the formations within them described as follicles and primordial ova have been falsely explained and have nothing to do with true follicles. He regards the term as justified only in a narrow morphological, but not in a histogenetic, sense.

Sternberg[20] thinks that the resemblance of the follicles and ovules in the granulosa cell cancer to true follicles is so slight that to term these structures folliculomata is entirely without justification.

Geist[8] observed that the cells composing the tumor resembled granulosa cells in

their appearance and arrangement, and that the general structure of the growth in some parts suggested the developing follicle, with many variations. He expressed the view that because of this morphological appearance, the arrangement of the tumor and the wide variations in its structure, it must be a cell of great potentiality that plays the rôle of origin. He thought, however, that such a cell was found in the embryonic rests described by Goodall[21] and others.

Goodall,[21] for his part, speaks of persistent embryonal structures capable of simulating "pseudo-ovogenesis."

Others, as Ingier,[5] von Kahlden,[2] Voigt,[16] and Krompecher,[15] accepted the view that the folliculoid formations in granulosa cell cancer are the result of degenerative processes. Meyer[18] also shared this view, and termed the process one of "liquefaction." Goldberger[17] thinks it unlikely that these tumors originate in the follicular epithelium. He regards it as more probable that they originate in the medullary cord or rete cells or their forerunner, the germinal cells, which, he says, are practically the only ones that are able to mimic the ovarian follicle.

Von Werdt,[9] on the other hand, concluded that there does exist a very special type of tumor derived from the granulosa of the follicles themselves. He observed that the epithelium of the tumors resembles throughout the germinal epithelium, that is, the epithelium of the ovular balls and membrana granulosa of the ripe follicles, as well as the granulosa strands described by Walthard.[19]

After an exhaustive study, Robinson,[11] who had previously followed the precautions taken by other authorities and had called the oval and round spaces in granulosa cancer "folliculoid or ovuloid formations," found unmistakable ovules in these spaces and demonstrated beyond a doubt the granulosa proliferations from their circumference. He thus became absolutely convinced that the granulosa epithelium which forms the parenchyma of this type of ovarian cancer originates in the already formed follicles and not from hypothetical embryonal rests; that they are the result of liquefaction or degeneration, but are the remains of real follicles.

While Robinson agrees entirely with those writers who urge the impossibility of postnatal follicular proliferation, he takes issue with those who deny that the follicle epithelium enjoys metaplastic and hyperplastic potentialities. He suggests that if other types of epithelium, exercising their function as secretory or defensive structures, may at times exceed their normal limitations of growth and develop malignant or benign tumors, it is entirely reasonable that the granulosa epithelium, with its peculiarly rich capacity for proliferation, should on occasion become the site of similar morphological changes.

This was also the view of Gottschalk[3] in 1899, who said: "There can be no doubt that we are dealing here with a new growth starting from the wall of the primordial follicle."

This follicular origin of the follicular cell carcinoma of the ovary is supported by a scrutiny of the structure of my tumor, as shown in Figures 1 and 2. Here the small, diffusely scattered cells are tumor cells. They can be seen proliferating from the circumferences of the round and oval spaces, in the characteristic way pointed out by Robinson.[11] Babes[22] also has called attention to the fact that in his case the cystic formations were lined with a layer composed of the same elements which compose the follicular formation of the tumor, and that they must be regarded as coming from the cystic dilatations of the follicle formations.

The question whether the cylindroid and the follicular forms that have been observed represent separate types of tumors or are different phases of evolution in the life history of one and the same tumor, is not difficult to answer. It is safe to say that such a differentiation has no basis in the nature of the tumors themselves, which is identical, but belongs only to the particular

stage at which the tumor is observed.

Thus Seifried[23] says that the lowest stages would be indistinguishable from a common medullary carcinoma; in a higher stage would be found such tumors as were described by v. Kahlden,[2] v. Mangershauser, Voigt,[16] Lönnberg,[24] H. Schröder,[25] Ingier[5] and Blau,[14] in which the formation of follicles would have remained in a primary stage; while the highest stage would be that of the oöphoroma, as described by Brenner,[10] v. Werdt[9] and by Seifried[23] himself.

Robinson[11] says:

> The classification of granulosa cell tumors into cylindroid, folliculoid, solid and other types, is only confusing. They are not different tumor entities, but different growth phases in the evolution of the same tumor. In describing the morphology we ought to indicate these phases, which would simplify tumor nomenclature.

With regard to the malignancy of the granulosa cell carcinoma, it is held by authorities in general that this is of relatively low grade. It is seldom found in mitosis; its spread is by extension and not through the blood or lymphatic systems; and it shows no tendency to infiltrative or destructive processes. Among all the forms of carcinoma of the ovary, this may be regarded as the most benign. As Robinson[11] pertinently observes, the close morphological resemblance of the granulosa cell carcinoma to the granulosa of the follicles makes the proliferation of these cells something not wholly foreign to the ovarian tissue, so that defensive reactions are unnecessary. The clinical course of these tumors bears further witness to their relative benignity.

CONCLUSIONS

1. Epithelial tumors are occasionally met with in the ovary, which exhibit a number of characters in common.
2. The epithelium of these tumors resembles throughout the germinal epithelium of the membrana granulosa and of the ripe follicles.
3. These tumors are marked by a tendency to form follicle-like cysts with a membrana granulosa, which in some cases contain ova.
4. The assumption seems justified that these new growths are derived from the germinal epithelium of the graafian follicles.
5. The malignancy of the granulosa cell tumor is of low grade.
6. A case is described in which the tumor had these characters.

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    Part 1, presentation of microphotograph of tumor from right ovary of thirty-six-year old patient; Part 2, detailed case report.

[For Remainder of References see p. 122.]

HEREDITARY AGENITALISM*

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THE cases to be reported in this paper present clinical syndromes which rarely have been observed as individual cases and apparently are extremely rare as a familial condition. In studying the literature on the subject of eunuchoidism and especially in the female, there are differences of opinion as to the organs of internal secretion that are involved, although various theories are offered. The fact that these cases are familial and also hereditary introduces a still more interesting problem.

In his book on endocrine diseases Falta[1] says:

> Eunuchoids we term, according to Tandler and Grosz,[2] individuals who, without being castrated, entirely simulate in their clinical manifestations the true eunuch type, or at least extraordinarily similar to it. They are either tall, or if complications are absent, at least not stunted in growth; they show the typical fat distribution of eunuchs, and eventually pronounced obesity; the epiphysial junctures persist abnormally long, the skeletal dimensions are characterised by an especial length of the extremities, and furthermore, the individuals show a definite psychical habitus. Finally, there is found a more or less pronounced disturbance of development of the genitalia with faulty development of the secondary sexual characteristics.

Tandler and Grosz postulate that with the female eunuchoidism changes have to be found which are similar to the male eunuchoidism, and demand for this dyscrasia that those disproportions of the skeleton which go with male eunuchoidisms exist also for the female eunuchoidism with the modification as existing for the female and that the sexual marks experience a similar hindrance. They further call attention to the fact that the circumscription of the clinical picture of eunuchoidism which they give is very often not strictly observed and that often cases of infantilism are grouped with eunuchoidism and vice versa. Characteristic of infantilism is the preservation of the childlike body form and they believe that the disproportion of the skeleton differentiates eunuchoidism from infantilism.

Guggisberg,[3] Aschner[4] and B. Wolff[5] call infantilism all those cases in which one or more organs of the body stop in a childish stage, but if certain glands with internal secretion, especially sexual glands, stay infantile then the retarding influence of growth is not present, the growing of the epiphysial lines keeps on and the result is overgrowth. Wolff believes that the narrowly described definition of infantilism is not justified. According to him all these symptoms belong in the domain of infantilism and he considers eunuchoidism only for a peculiar and at the same time interesting type of infantilism. In the cases described by Wolff, the individuals are unusually small, 1.20 to 1.50 m. He found in all these cases the phenomena of extremely long extremities compared to the body length and with all four patients the epiphysial lines were open at an age when they should normally be closed. These patients also had infantile genitals and none of them had menstrual periods in the ages of nineteen to forty-five years.

Lipschütz[6] wants to call such patients eunuchoid as have a congenital underdevelopment of sexual glands. These patients should morphologically and physiologically show the same signs as persons who were castrated in early youth. In the female eunuchoidism, Lipschütz like Tandler

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and Grosz wants to count those cases which have the symptoms already described, especially the disproportion of the body between the hypophysis and the gonads. He believes that the anterior lobe, the one responsible for acromegaly, inhibits the

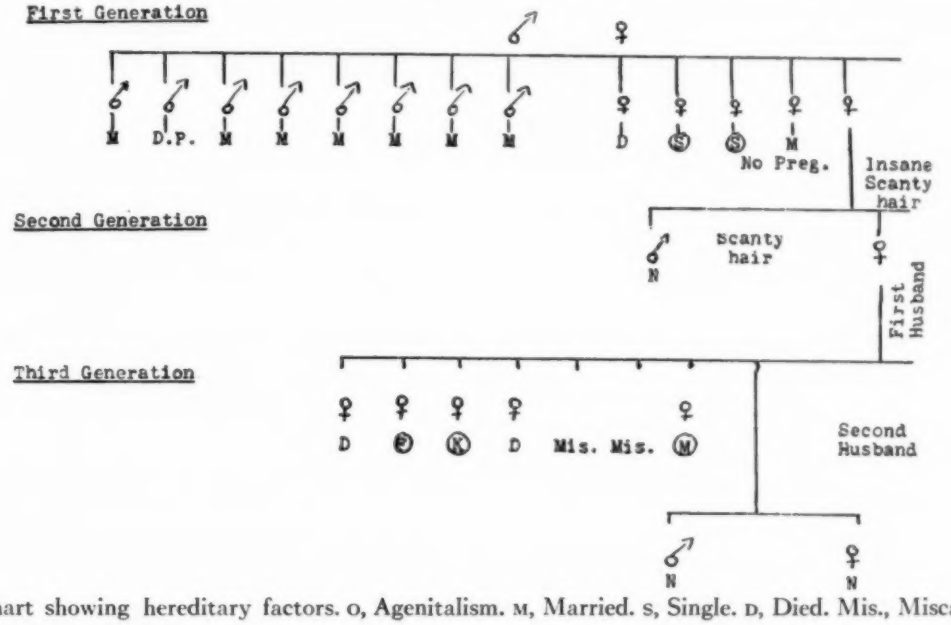

Fig. 1. Chart showing hereditary factors. o, Agenitalism. m, Married. s, Single. d, Died. Mis., Miscarriage.

forms as in the castrate types.

Aschner[4] believes that one should designate as female eunuchoidism only those individuals who are comparable with the female early castrates, which are tall lean individuals, with few fat tissues, poorly developed mammae, infantile genitals, lean buttocks and scanty body hairs. Guggisberg[3] considers the main difficulty in the definition of eunuchoidism as due to the fact that the consequences of early castration are not very clear. We have according to him no satisfactory reports of the early castration of the human female.

Zambaco Pasha[7] claims that in eunuchoidism the gonads are not the only glands affected, but that the entire system of glands of internal secretion must be damaged in order to produce the clinical picture of the eunuchoid. Pende[8] reviews the subject of eunuchoidism and lays stress on the relation of the pituitary to the gonads. Goldstein[9] ascribes eunuchoidism to a pluriglandular disturbance. He, however, again repeats the hypothesis of Tandler and Grosz[10] that there is a mutually double interaction, inhibitory and acceleratory, sexual apparatus, while the posterior lobe accelerates it; that is, the two lobes are antagonistic to each other. In states of eunuchoidism the balance is lost and abnormalities in growth result which will depend on the predominating lobe. If the anterior lobe leads, there will be an abnormal growth of the skeleton; if the posterior lobe leads, we have a fat, bloated individual.

The classical obesity, interpreted as a "hormonic" sign of posterior lobe hypopituitarism, consists of girdle and mons adiposity, to which in some cases is added mammary adiposity. Its character and location have suggested secondary insufficiency as its origin, because this frequently accompanies the bipolar cases with anterior lobe insufficiency. An argument against this cause of the obesity is that it is absent in the pure anterior lobe insufficiency in which there is complete aplasia and absence of function of the gonads. There have been observed 2 cases of females, thirty-six and thirty-eight years of age, in which there was complete amenorrhea and infantilism of the genitalia during the entire life,

without the development of this typical adiposity.

Absence of girdle, mons or mammary obesity, the negative evidence of disturbance of metabolism such as carbohydrate tolerance and the complete and prolonged freedom from such constitutional symptoms as headache, eye disturbances, nausea, vomiting, abdominal distention, polyuria, polyphagia, polydipsia, etc., prove conclusively that the posterior lobe was not involved. Cushing,[11] Falta and others have ascribed the aplasia of the genitalia and the lack of the secondary sex development to the involvement of the posterior or nervous lobe of the pituitary. That insufficiency of the gonads and the negative sex characteristics are really hormonic signs of the anterior instead of the posterior lobe of the hypophysis is now conceded by Cushing as well as by many other investigators in this field. Nearly all authors are now agreed that the disturbance of osseous growth can be assigned to the anterior or so-called glandular lobe of this gland. It seems needless to add that the diagnosis of the osteoplastic variety is evident from the small sella turcica, and the absence of intracranial pressure symptoms either general or near the pituitary.

A detailed perusal of the hormonic signs referable to insufficiency of the anterior lobe occurring before maturity (pre-adolescent variety) demonstrates that the undergrowth of the skeleton is an absolute, constant sign.

Guggisberg[3] calls eunuchoidism a clear case of hypogenitalism and he believes that it is very difficult to explain how many are dependent on poor functioning of the ovaries and how many symptoms depend on dystrophic disturbances or constitutional subnormalities or changed action of other internal glands.

Timme[12] states that the complete loss of ovarian function before puberty results in female eunuchism. Menstruation never takes place; the breasts remain undeveloped; there is a tendency to reverse hair distribution; the arms and legs become disproportionately long; the buttocks are lean; and sexual feeling does not develop.

Zondek[13] describes 2 cases in which he shows that the congenital hindrances of evolution of the genitals can cause the characteristic symptoms of eunuchoidism in female individuals. Berg[14] describes a case in which he attempts to draw a line between eunuchoidism and infantilism and thereby concurs with the opinion of Tandler and Grosz, Lipschütz and others. This case came to autopsy.

Berg[14] described a case of female eunuchoidism which was observed in the Medical University Clinic of Rostock.

> The patient was twenty-eight years of age and had had up to that time no menstrual period. There was no history of a similar condition in the family. The disproportion of the skeleton was very noticeable. The extremities were long in comparison with the rest of the body. The secondary sexual marks were scarcely developed. The axillary and pubic hair were sparingly present. The breasts were missing and the nipples only indicated. The body was lean and the muscles and fatty tissues moderately developed. The genital examination showed externally a perfectly normal appearance, with hair sparse and pale in color. The introitus vaginae was very small and barely allowed the passage of a finger. The uterus was about as long as the length of the first phalanx of a finger. The examination of the nervous system showed nothing abnormal.
>
> At autopsy the left tube and ovary were grown together with the lateral wall of the abdomen. Both ovaries were small, whitish, entirely flat objects comparable to senile ovaries but without any grainy hills. They were situated alongside the small uterus. The neck of the uterus was 2.5 cm. long, same size as the uterus itself. The uterus was skinny and pale. The thymus was not noticeable. Flaps of thyroid glands were present on both sides, 5:1.5:2.5 cm. large, eve, glassy, pale bluish.

Finally, we find that Curschmann[15] in his discussion of agenitalism presents the following interpretation:

Complete absence of gonadal function results either from a congenital defect in the sexual glands or from one occurring in early youth or later. Congenital total aplasia is admittedly a rarity; it appears either as an isolated defect or, much more often, as part of a severe constitutional dysplasia especially in hereditary diseases such as Friedreich's ataxia, myasthenia, myotonic dystrophy, Erb's dystrophy and hemolytic icterus.

When agenitalism occurs soon after birth we find the symptoms which have been made familiar in Oriental eunuchs and Roman soprani. The subjective and functional sexual life is usually lacking in both sexes; in women menstruation is absent. The secondary sexual characteristics do not develop. No hair grows on the face, but there is no tendency to baldness. The body-hair remains weak or entirely absent. A noticeable feature of the bony growth is the lateness of fusion of the epiphyses, a factor which leads to eunuchoid tallness. In addition to this the legs are remarkably long; when the patient stands up he looks a giant, the length of the arms is also abnormal. The trunk skeleton usually shows no anomalies. The fat deposit behaves in various ways. In tall eunuchs of either sex it may be normal or even remarkably scanty. Castration obesity, on the other hand, usually affects persons of medium build. It has been noted that a few cases of lean, tall "eunuchism" have been observed in women. They show a certain approximation to the characteristics of the opposite sex, and have peculiarities of proportion and psychic outlook very similar to those of male eunuchs.

Other endocrine disorders commonly associated with agenitalism are hyperplasias of the pituitary and the thymus. It is very probable that the development of obesity in agenitalism depends largely upon the function of the thyroid and pituitary. The heart in the lean, tall types is generally small and narrow, sometimes occupying a central position, the pulse is usually slow and the blood-pressure decreased. There are no organic changes in the nervous system, and the mental outlook in congenital or early agenitalism usually suffers no morbid change.

Falta thinks that eunuchoidism in the female sex seems to be seldom found. This seems to be one phase of this subject that the various authors have agreed upon. To find more than one case in a family is so rare that Irene Yates[16] in describing her 2 cases in sisters, states that she has been unable to find any other report of familial eunuchoidism in the female in the literature.

Yates described 2 cases in sisters aged twenty-two and twenty-four years, of a family of four children, three girls and one boy. The boy, aged seventeen years, was tall but showed nothing abnormal. The sister, aged nineteen years, was normal in height and menstruated regularly. The father was tall; the mother was of normal height and had a normal menstrual history. Examination of the sisters showed no development of breasts, or axillary or pubic hair. The external genitalia were of the infantile female type. The uterus and ovaries were not palpable. The arms and legs were long in proportion to the height, measurement from the umbilicus to the ground being 70 and 66 per cent of total height instead of the usual. They both had sallow complexions and boyish manners. The x-ray showed epiphyses of the long bones to be still separate from the shaft, the hands of the male type. Neither showed attraction for the male sex.

In the family to be presented in this paper the history of the grandparents was obtained from the mother of the three girls examined.

The paternal grandparents had seven children, six girls and one boy. The grandfather died of smallpox and the grandmother of apoplexy. Five of the six girls married; the oldest died at the time of her first childbirth; the second had one child; the third has had no children; the fourth has had nine, five boys and four girls, apparently normal; the fifth has had one child. The boy is the father of the girls in this report. As far as can be determined without an actual examination of the different members of the father's family, there

is no evidence of an endocrine imbalance. There is no history of epilepsy, insanity or other neurological condition in any member of the family, although it is said that the father of these girls died from opium poisoning. This report cannot be substantiated as the parents had not lived together for seven years prior to his death.

On the maternal side, the great grandparents had thirteen children, five girls and eight boys. One boy was committed to a State Institution for the Insane with a diagnosis of dementia precox at the age of twenty-one years. The other boys grew to manhood apparently normal, married and their children were normal as far as can be determined. Of the five girls, one died in infancy, cause unknown. Two girls never developed hair upon the body, axilla or pubis and never menstruated throughout their lifetime. These women remained single and lived to the ages of sixty-four and seventy-one years. One girl married and although her hair distribution was of a normal type and her menstrual periods were present, no pregnancy occurred. The fifth girl was the grandmother of the children in this report. She was well and healthy up to the age of fifty-two when she became insane at the time of her menopause. She was committed to a State Institution for the Insane and died two years later. The hair in her case was normal in distribution but scanty in amount. The grandfather died from the result of an accident at the age of sixty-four years.

The grandparents had two children, one boy and one girl. The boy is living, married and there is one son which is normal. The girl, who is the mother of the girls in this report, is living and is forty-three years of age. She never developed any axillary hair nor hair upon her body except a small growth of pubic hair after the age of thirty. She had one period at thirteen years of age and then no more until after she was married at seventeen years. The periods then became regular, of the twenty-eight day type, and five days' duration. She has had nine pregnancies, seven with her first husband and two with the second. All the deliveries were difficult as the physicians have told her that her pelvis was small and it had been necessary to use instruments with each delivery. The first child was a girl who started to walk and talk at twelve months of age but at eighteen months developed some brain condition which resulted in the paralysis of one leg and a strabismus. This child died after two weeks of illness, cause unknown. The second and third children were Florence and Katherine of this report. The fourth was a girl who died at eighteen months, cause unknown. The fifth and sixth were miscarriages. The seventh was Marion of this report. The eighth and ninth were by the second husband and resulted in a girl (Hannah) now aged fourteen and a boy aged thirteen years. Although Hannah has no body, axillary or pubic hair, her periods began at twelve years of age and are regular up to the present time.

The three girls to be discussed in this report resemble each other in their type of physical make-up.

	Age	*Height*	*Weight*	*Pulse*	*Bl. Pressure*
Marion.....	19	168 cm.	123 lb.	104	128/70
Florence....	23	170 cm.	118 lb.	88	116/74
Katherine..	24	171 cm.	139 lb.	112	118/76

MEASUREMENTS OF EXTREMITIES (CIRCUMFERENCE) (CM.)

	Marion	*Florence*	*Katherine*
Left arm.....	21.5	24.	24.4
Left forearm.....	21.3	22.	22.4
Right arm.....	23.4	24.4	25.4
Right forearm.....	19.8	21.8	21.4
Left thigh.....	42.6	47.4	41.2
Left leg.....	33.8	34.2	33.9
Right thigh.....	42.8	47.6	41.4
Right leg.....	34.2	34.6	33.6

All three girls began to walk and to talk at about one year of age. They developed in a normal way up to the age of puberty when the mother noticed that they were unusually tall and very thin. It was impossible for them to gain very much weight. They made rapid progress in school and later obtained responsible business positions. All three have been unusually healthy up to six months ago when Florence began to lose weight and cough. At this time she began to have a fear of death which resulted in an inability to sleep. She became afraid that she was going "crazy." Examination of the chest showed an active tuberculous process.

None of these girls has ever menstruated. All three show the same type of temperament. They are very much interested in their respective positions and take very little interest in outside activities. They have no hobbies and lead a monotonous type of life. They take no

interest in the opposite sex. They are very cold towards each other and also their mother. The mother states that even as children they were never affectionate and appeared annoyed when caressed by relatives. They have always been irritable and fought among themselves. They were and are never affected by sadness in the family and seldom weep and when they do it is in the height of anger. They spend most of their spare time reading.

Physical examination shows in each case a well-developed head of hair. The hair is very fine and silky. Eyebrows and lashes are normal. The texture of the skin is smooth and velvety to the touch. There is no axillary, pubic or body hair. The teeth are well formed. The arms are long and the hands are large. The fingers are long. The breasts are poorly developed and the nipples are small. There is very little adipose tissue but the muscles are well developed with excellent muscle tone and have more of the appearance of the muscles of a man. One would believe by the appearance of the muscular development that these girls were accustomed to strenuous exercise but their activities are limited to walking. The pelvis in each case is small. The buttocks are lean. The general shape of the thoracies is long and narrow although that of Katherine is somewhat different as will be noted in the *x*-ray description.

There is no enlargement of the thyroid and the thymus cannot be determined by percussion. Examination of the heart, lungs and abdomen was negative for pathology or abnormalities in each case with the exception of the tuberculous process in the lungs of Florence.

The external genitalia are of the infantile female type, apparently normal as to formation. Vaginal examination was impossible, but a small uterus about 1 cm. in length could be felt by rectal examination. The ovaries were not palpable. A complete blood examination, Wassermann, urine analysis and blood chemistry was done and was found to be within normal limits for each girl.

An *x*-ray examination of the thoracies and sella turcicas was made by Dr. A. L. L. Bell, director of the Department of Radiology, Long Island College Hospital. The result of this examination was as follows:

"As to the general shape of the thoracies, Florence and Marion each show rather narrow long thoracies, of approximately the same breadth in the upper portion as in the lower. However, in the case of Marion the breadth below is slightly greater than that above. Katherine shows an entirely different type thorax, being of moderate breadth above and considerably broader below. As regards rib formation all are similar except that the changes previously described would make them different in shape. The shoulder girdle is similar in the case of Florence and Marion but the shoulders are considerably higher in the case of Katherine. The position and shape of the diaphragm, being determined more or less by the shape and type of the thorax, is similar in the cases of Florence and Marion, the dome being at the level of the sixth interspace anteriorly in both instances and with a rather flat curve. In the case of Katherine the level of the diaphragm is the same but the diaphragmatic curve is more accentuated.

"Heart: Florence's heart is the typical ptotic type which one expects in this type thorax, the total transverse diameter of the heart is 10 cm. Marion's heart is not of the ptotic type which one would also expect in her type thorax with the slightly broad lower portion; it measures approximately 11.25 cm. in the transverse diameter and is more conventional in shape. Katherine's heart is similar in shape to Marion's; its total transverse diameter is 12.5 cm.

"As regards the sella turcicas, in looking over all three, one is struck by the dissimilarity in shape and size in the three cases; in the case of Florence, the sella turcica is rather large, roughly oval in shape, clearly outlined with well-defined and prominent anterior clinoids and dorsum sellae. Marion's sella turcica is very much smaller and while the anterior clinoids and dorsum sellae are well seen and prominent, they are somewhat different in shape and type than seen in the first case. Katherine's sella turcica in size varies between the first two, it is more nearly oval in shape with anterior clinoids and dorsum sellae appearing more like those in the case of Florence. The general sphenoid bone structure is the same in all three cases except that the size and shape of the various sphenoid sinuses vary in densities."

The family studied in this problem presents several unusual observations. These findings go back to the third generation in which there were eight boys apparently showing none of the signs or symptoms of

agenitalism as seven were married and had normal children. The eighth boy was committed to an insane institution as a dementia precox case. There were five girls in this same generation. One died in infancy. Two girls never menstruated nor had hair on the body. One menstruated and had normal hair development but there were no pregnancies. The fifth girl was the grandmother of the girls described in this report. She had menstrual periods but scanty hair development. There was a boy and a girl born from her marriage. The boy was apparently normal. The girl was the mother of the girls in question. She never developed axillary hair nor body hair except a slight growth of pubic hair after the age of thirty. Her menstrual periods were late in establishing their regular cycle. All of her children by her first husband were girls. Two died in infancy and the other three were similar in development and all three present the same syndrome of agenitalism. A boy and a girl have been born of the second marriage. The boy is normal and the girl has her menstrual periods which are regular but at the age of fourteen has no body, axillary or pubic hair.

In presenting this report of this family, I wish to call attention again to the fact that that agenitalism in the female is a rare condition but to find it on a hereditary basis is practically unheard of, as I have had the same experience as Irene Yates and have found no other instance of familial or hereditary agenitalism in the female in the literature.

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MYOSITIS OSSIFICANS PROGRESSIVA

CLINICAL NOTES AND ROENTGEN FINDINGS OF A NEW CASE

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THE solution of a baffling diagnostic problem frequently loses its interest if presented as a stereotyped case report. In order to prevent this we venture a chronological record with the interspersion of personal reactions, trying not to depart from scientific accuracy.

The production of inlaid linoleum required Mr. H. S., aged thirty-seven, white, to support his weight upon his right arm while he placed the plastic squares in position on a moving belt with his left hand. On February 1, 1929 he began to suffer pain in his right shoulder near the spine, and reported to the company physician* on the fifth because the pain prevented him from continuing his occupation. A mass, semi-ovoid, 2 by 3 inches with its long axis in the line of the spine, raised one inch from the normal contour, was found at the upper vertebral angle of the right scapula, displacing it laterally.

The skin over this area was freely movable, scarlet, with a few dilated venules, but no accentuation of the sweat gland orifices. The swelling, which was in or beneath the deep fascia, was painful but not tender, indurated, wooden-like with a definite tenseness or resiliency and showed increased local temperature. One might say that it felt like an intradermal wheal looks, imagining the wheal to be of tremendous size and intramuscular.

In one week the mass trebled in size, increasing by spreading inferiorly to the twelfth rib. The patient was referred for *x*-ray therapy March 5, 1929 with the diagnosis of sarcoma, in which we concurred. The location was not an unusual one for fascial sarcoma. An unfavorable prognosis was given because of the great malignancy of lesions adjacent to or in the shoulder girdle. (Fig. 1.) Upon examination we found very small bilaterally enlarged axillary lymph nodes. There was no other adenopathy and the spleen was not enlarged. The patient had a mild degree of trismus which was of years' duration, and a peculiar copper-colored halo on the forehead one-half inch below the hair line. The past history revealed nothing of note. Roentgenograms of the chest, spine and shoulder girdles were normal.

X-ray therapy was instituted through two 10 × 10 cm. fields directly over the tumefaction. Ten days later regression began, leaving a deep irregular fibrosis, when to our consternation a new swelling appeared beyond the lower border of the previously treated areas. The radiologist immediately reproached himself for limiting the treatment fields and renewed treatment over the new area with a field 20 cm. in diameter. To our amazement the migration continued anteriorly into the pectoral region and halted at the reflection of the fasciae embracing the right clavicle (Fig. 2).

After temporarily stopping at this point for ten days the anterolateral cervical regions became involved, April 19, 1929, the neck increasing from a normal circumference of 16 inches to 17.5 inches in seventy-two hours. On April 26 it had increased to 19 inches, with the typical appearance of a strumitis except that the entire neck was involved from trapezius to trapezius (Fig. 3).

We found by treating one-half of a number of lesions and protecting the other half that the *x*-rays did not influence the rate of regression. In spite of severe dyspnea and dysphagia the patient survived and regression began so that by May 10 the circumference of the neck was normal again. Thoroughly frightened by his dyspnea, the patient consented to hospitalization but refused biopsy. Temperature and respiration rates were normal; the pulse was accelerated, varying from 86 to 105. Blood Wassermann reaction negative. Blood chemistry: sugar, urea nitrogen, uric acid and creatinine normal. Blood count: Hb. 97 per cent; R.B.C. 4,120,000; W.B.C. 6000. Differential count: polymorphonuclear neutrophiles 73 per cent; lymphocytes 25 per cent; large monocytes

* Reported through the courtesy of Dr. C. P. Stahr, Medical Director, and from the X-ray Dept. of the Lancaster General Hospital.

2 per cent. Urinalysis negative.

Consultation with the Radiological Staff of the Philadelphia General Hospital was sought

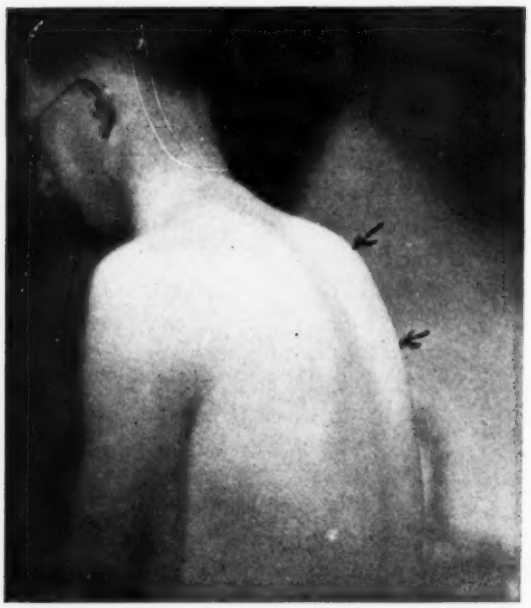

Fig. 1. Original mass at time of its greatest size, showing spreading downward along border of right scapula. March 7, 1929.

and on the occasion of his presentation the following observations were made:

1. The tumefaction occurred beneath the deep fascia.

2. The manifestations of local inflammation were not followed by suppuration or accompanied by the general systemic signs of inflammatory disease.

3. The swelling migrated from muscle to muscle, respecting fascial reflections by temporarily halting.

4. *X*-ray therapy did not influence the course of the disease.

During the next few months the patient improved considerably, gaining weight and strength, but not recovering the mobility of the right arm. Other tumefactions had occurred, appearing on the left side of the body for the first time, except for the cervical imvolvement. In September, 1929 the patient reported for observation (Fig. 4) and was greatly improved. He complained of "sticking pains" in the chest which were not influenced by deep breathing, also profuse night sweats. The massive lesions were gone but deep in the previously involved muscles, irregular, nodular fibrotic areas remained.

There were several discrete masses in the right submaxillary region and trismus, preventing all but lateral jaw motion. The right arm was fixed to the side, as the result of fibrosis

Fig. 2. Note involvement of right pectoral region extending up to clavicle. Skin discoloration along line of migration follows course of latissimus dorsi. Pectoralis major (right) is completely involved. March 22, 1929.

in the pectoral muscles.

He had not lost or gained weight. The cardiac area was enlarged to the left, rate 126, sounds weak and muffled but without murmurs. B.P. 106/76. The previously noted gland in the right pectoral region was more discrete and harder than previously.

After much persuasion the patient consented to biopsy March 28, 1930 and the removal of the pectoral node was undertaken. To our surprise the surgeon cut down upon a sheet of solid bone and removed some of it with the adjacent muscle for study. The pathological study made by Dr. Louise Keasbey revealed normal bone with a well-formed cortex and marrow cavity. Microscopic sections showed the presence of normal dense fibrous tissue, voluntary muscle and well-formed bone. No evidence of neoplasm, or signs of inflammation. Roentgenograms revealed extensive deposition of bone in both pectoral regions and not elsewhere (Fig. 5).

We then realized that we were dealing with a case of myositis ossificans progressiva. The

trismus present before the present attack may have been the only residuum of the first paroxysm, unremembered in childhood, or congenital. The patient did not have the thumb deformities noted by other authors, but did have incompletely formed joints between the phalanges of the great toes. No bone could be demonstrated in the muscles of the back which had been involved.

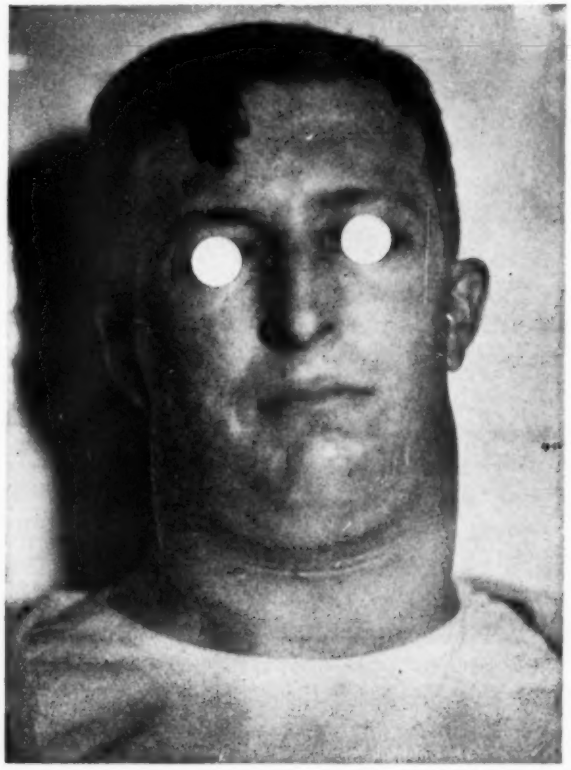

Fig. 3. Massive involvement of all superficial cervical musculature anteriorly. April 19, 1929.

The patient so far recovered that in January, 1931 he was driving a truck, hampered, however, by the pectoral fibrosis.

HISTORICAL ASPECTS OF THE DISEASE

In 1689 Guy Patin[1] in writing to a friend mentioned having seen a patient suffering from what Pirie[2] in translating the letter regards as a case of this disease. Perhaps the most complete resumé in recent years is one by Rosenstirn[3] of San Francisco in which abstracts of all cases before 1918 are presented with those of his own personal observation. In 1923 Nutt[4] brought the matter to light again, adding 10 more cases, 9 from the literature and one of his own, and MacKinnon[5] in the following year made a further report, adding another. Discarding those cases not of the true progressive type, there were 132 on record in 1924. Magruder[6] reported a case in 1926 in which radium was used postoperatively without avail.

Fig. 4. Military attitude of patient is due to fibrosis of musculature, and is not assumed. Note swelling in right submental region and copper-colored halo on forehead. September 24, 1929.

More recently Frejka[7] in a brilliant article delves into the pathology of the condition and the stages clinically discernible during the course of the disease. I shall take the liberty of drawing largely from his work for it is exactly similar in its clinical aspects to our own observations.

PATHOLOGY

Bone is essentially of mesenchymal origin, and its occurrence in situations other than those common to the skeletal system is not unusual. It is encountered in postoperative scars; in the cicatrices of burns; following trauma, in the muscles as in rider's leg; after arthritis, in the

capsules of joints and occasionally from transverse cord lesions. With these conditions, there are some local or known

Fig. 5. Roentgenogram of right shoulder girdle March 28, 1930. Note intramuscular bone growth.

causative factors, whereas in myositis ossificans progressiva the local incitant is not discoverable. In all these pathological states connective tissue is the predominant histological structure, except in myositis ossificans progressiva where muscle is the predominant structure. It is important to determine whether the muscle fibers *per se* undergo metaplasia into bone or whether the intermuscular connective tissue is changed.

From the histological studies at our command, notably Münchmeyer's[8] in 1869, the disease seems to involve primarily the voluntary muscle fibers with the loss of striation without round cell infiltration or inflammatory exudate. He describes three stages, which correspond so accurately to our observations clinically that one can entertain no doubt as to his veracity and accuracy. In the first stage, the muscles are edematous, swollen, dense in some parts with compact tumors of rosy-golden color. One wonders if he might be describing xanthoma.

In the second stage fibrous condensation occurs. We noted this in our patient, it required four months to develop after the subsidence of the original tumefaction. The muscles were inelastic and nodular.

In the third stage ossification occurs. The time required seemed to be six months, the observation of the particular mass removed was made six months before that time. As recently as 1914 Weber and Compton[9] studied a biopsy from such a mass. At operation they removed an involved portion of the latissimus dorsi which was hard and white and miscroscopically showed the invasion of normal muscle by newly formed fibrous connective tissue, resembling fibromatous hyperplasia. There were no inflammatory products noted.

It would seem from these considerations that the muscle fibers are destroyed first and the intercellular fibrous tissue reacts to its destruction as it does elsewhere, producing excess connective tissue. This connective tissue proceeds to bone formation as is noted in many other pathological conditions, but very rapidly. I do not therefore consider it a true metaplasia of muscle.

Gegenbauer's theory of bone production is, that bone is a secretion of connective tissue cells and it is therefore extracellular. As opposed to this Waldeyer asserts that the degeneration and dissolution of osteoblasts produces bone, consequently we must admit the assumption of osteoblastic propensities by connective tissue cells to account for the occurence of bone in muscle.

CONGENITAL ASPECTS OF THE DISEASE

In the majority of the cases reported there has been hallux valgus, with the absence of one or more phalanges of the great toes, or (and) similar variations in the thumbs (microdactylia). Kraus and Trappe[10] in 1907 found 70 per cent of the

reported cases possessed this anomaly, and certain authors have expressed the thought that it is a congenital defect of the mesenchyma. Virchow believed it was related to the entity known as multiple cartilaginous exostosis. Von Dusch, who proposed the commonly accepted name for the disease, regarded it as a constitutional disease associated with inflamed muscles, occurring in periodic exacerbations. Goto[11] believed it to be a fascial and intermuscular connective tissue disease. It is singular that if this is a congenital defect in the mesenchyma and the toe and thumb are the embryonic precursors, that the extrauterine manifestations of the disease show a predilection for the trunk muscles.

If we weigh the evidence carefully it must be admitted that there is an underlying congenital factor. The predominance of the thumb-toe deformity and the frequency of onset in childhood are too consistent in their occurrence to lead us to any other conclusion. On the other hand the precipitous nature of the attacks and our inability to influence the course of the disease suggests a second factor, namely a metabolic imbalance.

Numerous routine blood chemistry studies have been made and nothing abnormal noted. Magruder reports the blood calcium of his patient as normal; and in this case the blood calcium was normal when taken February, 1932. This, however, is not important as the examinations in both cases were not made during the exacerbations of the disease. One may find crystalline uric acid deposits in the ear or toe long after the blood uric acid has returned to normal, and I see no reason why the blood calcium should not behave in a similar manner.

SUMMARY

1. A case of myositis ossificans progressiva is reported with the emphasis upon the clinical aspect.

2. The three stages in the clinical course of the disease are indicated, emphasizing the difficulty of early diagnosis.

3. It is suggested that this is a metabolic disturbance on a congenital background.

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VENTRAL HERNIA

A NEW TECHNIQUE IN ITS REPAIR

VINCENT FARMER, M.D.

HACKENSACK, N. J.

MASSON[1] reports from the Mayo Clinic for the period 1915–1920 that 2 per cent of 28,970 abdominal operations were for postoperative hernia and that 33.8 of all postoperative hernias occurred through low midline incisions.

An anatomical examination of the abdominal wall shows that the fibers of the main supporting structure, namely the aponeurotic bundles of fibers, to a large extent lie transversely. This is especially true of the fibers of the transversalis fascia in the lower abdomen. A study of the dynamics of the abdominal wall shows that this is essential as the lateral tension is apparently greater than the vertical. One frequently notes a considerable diastasis of the rectus muscle without a hernia but only when there is no separation of the aponeurotic fibers. Therefore, in an adequate repair of the abdominal wall, it is necessary to strengthen and replace these transverse supporting fibers not along the axis of the hernia but for a considerable distance perpendicular to this line.

In many cases the greater part of the anterior abdominal wall, apart from the postincisional region, is weakened, stretched and atrophied and it is of great importance to take cognizance of this fact in the technique so as to prevent recurrence after repair of large hernias.

To obtain the best results it is essential that the edges of the fascia layer, whether imbricated or not, be allowed to heal without tension. When there is pulling on the line of suture considerable connective tissue forms between the edges or there is union only at points or union is followed later by stretching of the scar; consequently, there is a predisposition to recurrence, which is more likely to develop in patients who are obese because of the poor quality of the tissues.

Alcohol-preserved dead ox-fascia strips are used in such a manner in this technique as first to obviate all tension on the suture line by distributing the tension over a large area of the muscle and its overlying fascia and second to give the fascia strips as much contact as possible over a large area of muscle fibrous tissue. We thereby create strong transverse bands of revived tissue which lend powerful support not only to the area of incision but to the surrounding tissues as well, so that the entire structure is better able to withstand the increased intra-abdominal pressure which follows these procedures.

Koontz[2] has shown that in the repair of inguinal hernias the amount of fibrous union and scar-tissue formation was greater when raw muscle surface was brought into contact with the ligament; because the fibrous components of the muscle were brought into more intimate contact and thus afforded wider contact for fascia-to-fascia union, on which the strength depends. The use of living sutures by Gallie and Lemessieur[3] affords a chance for an even more intimate union by furnishing a living bridge of fibrous tissue extending from the ligament into the very heart of the muscle. That this same living bridge can be ultimately produced by using strips of alcohol-preserved fascia-lata of the ox, Koontz[4] showed in a paper published in 1926. The collagen fibrils of fascia are inert substances in the living animal, and are entirely unaltered by their preservation in alcohol, so that when these strips of fascia are placed in another animal, they act in no way as a foreign body, producing

phagocytosis and a foreign body reaction, but are invaded by new cells and fibroblasts from the host, thus in a short time becoming revivified and acting in exactly the same way as the "living structures" of Gallie and Lemessieur. The obvious advantage of this material over the "living structures" is that it can be kept ready for use in the operating room, it is uniform in width and strength and it is not necessary to perform an additional operation in order to obtain it.

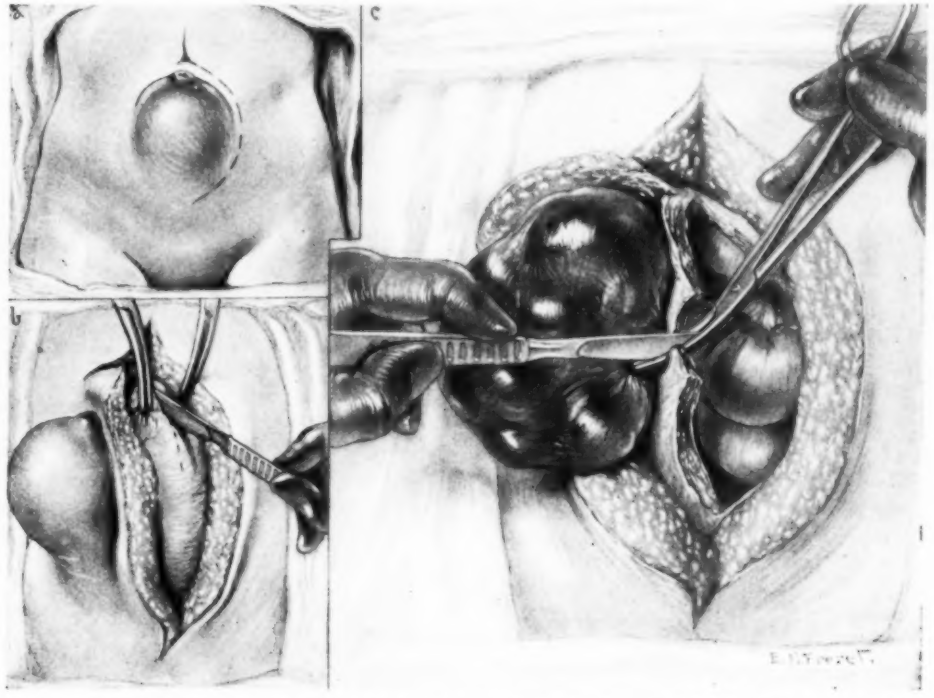

Fig. 1. A. Incision for ventral hernia where sac is large and there is danger of injuring gut. B. Exposure of one-half of inside of sac. C. Approach to neck of sac.

ANESTHESIA

Of all procedures in which local anesthesia is used those which concern the abdominal wall give the most satisfaction to the patient and to the operator. In extensive repairs a considerable amount of solution (0.5 to 1 per cent novocaine-adrenalin solution) may be required. We may greatly reduce the amount by freeing the skin and fat, anesthetized by the subdermal method, before injecting in the fascia. The hernial sac may extend some distance beneath the skin and in these cases care must be exercised not to inject too close to what seems to be the limit of the sac. If doubt exists it is best to inject the fascial and peritoneal layers after they have been exposed. However many surgeons still prefer spinal anesthesia.

TECHNIQUE

If the patient is extremely obese with considerable depth of fat in the abdominal wall, it is advisable to make a large transverse incision, remove the portion of skin and subcutaneous fat and then make the incision through the muscle in the median line. In cases in which the sac is small it may be readily excised, and the peritoneum sutured, the edges of the muscle thoroughly cleansed and brought together and then an over-lapping closure of the external sheath of the rectus can be made. If the hernia is large and the muscles widely separated an imbrication of the peritoneum and fascia is necessary, a plastic closure of the Mayo type bringing the cleansed

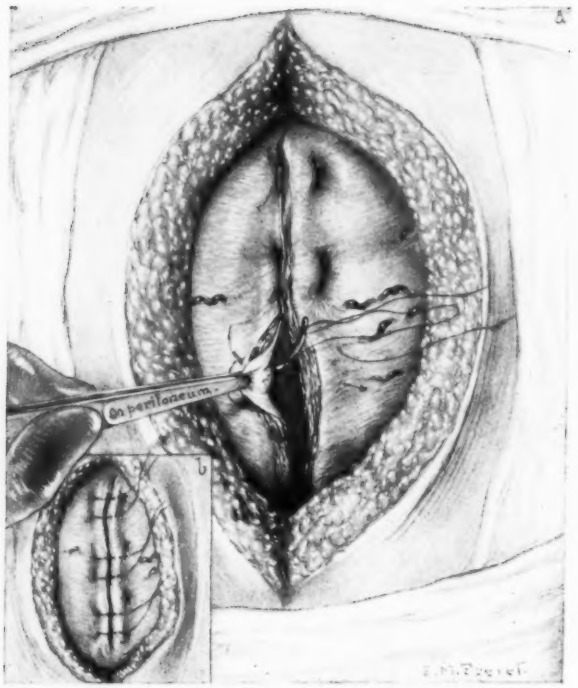

FIG. 2. A. Interrupted mattress sutures everting transversalis-peritoneum layer so that peritoneum comes in contact on each side. B. Bringing fascia layers together by overlapping with chromic catgut sutures.

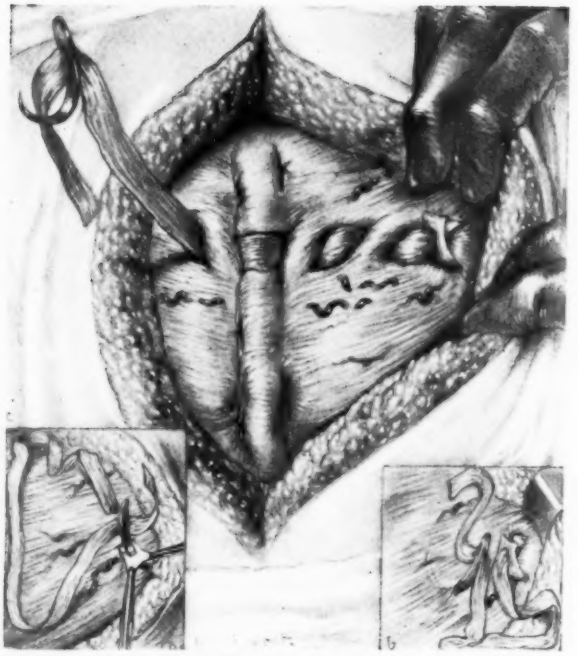

FIG. 3. A. Gratz[5] needle, first suture. B. Depth of bite. C. Fascia drawn tight and deep through tissues.

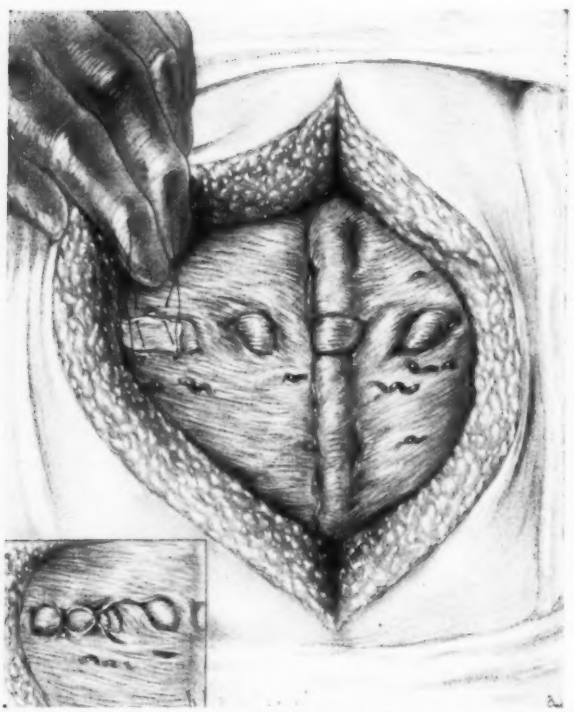

FIG. 4. A. and B. Best method of anchoring with linen thread so that anchor is secure without weakening fascia strip. Compare with Figure 3 where fascia strip is split transversley by needle. Same suture may be utilized in different places along strip, covering surface with tissue.

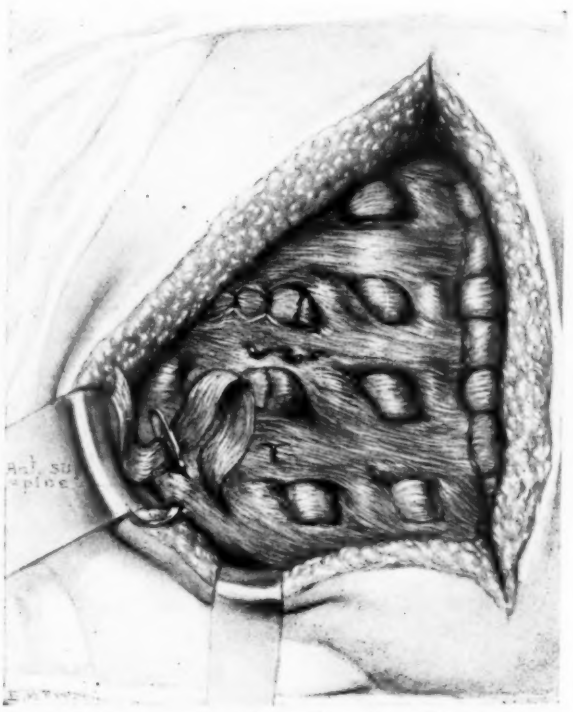

FIG. 5. Strips extending laterally, where tissues are not so stretched or atrophied, placed between blood vessels supplying skin and fat, latter being retracted for illustration.

peritoneum over the scarified fascia or rectal sheath. In doing this too much time can not be taken in order to cleanse the tissues thoroughly before they are approximated by interrupted mattress sutures. In doing this much tension is required to cause the edges to overlap and it is here that the ox-fascia strips placed transversly as shown in the illustration are of the greatest benefit.

Where the sac contains omentum or bowel with numerous adhesions, often in a multilocular fashion, it is well to enter the peritoneum above the sac, insert the index finger into the abdominal cavity and with the finger as a guide carefully dissect the rim of the sac on one side. The skin and subcutaneous tissue covering the sac may then be lifted and the dissection completed without injury to the bowel. It may be advantageous to leave parts of the parietal peritoneum attached to the bowel.

In patients where the surgical risk is very uncertain it is expedient to place ox-fascia strips, as illustrated, to strengthen the fascia and muscle layers and partly reduce the defect in the first operation. The second stage consists of dissection of the layersand an overlapping procedure as described.

COMMENTS

We have used fascia both living and dead of varied sizes and shapes in varied ways in hernioplasty; and have had opportunities of viewing the results. Our conclusions are that large fascia strips of living structures do not become vivified. This is more obvious when the strip, whether living or dead, is not placed so that every centimeter is in close contact with living tissue having ample circulation. We have also observed that the results are more favorable when the strip is inserted deeply with tension through the tissue rather than being sutured in place on the surface. The recurrence is less frequent and the number of operable cases increased. In the postoperative care one need not be concerned about the tension on the suture line; abdominal binders are not needed and the patient is more comfortable. This method is founded on a true anatomical basis.

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SOME OBSERVATIONS ON THE TREATMENT OF PILONIDAL SINUS

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ALL of us are confronted from time to time with problems in minor surgery which demand as much skill and as mature judgment as many of our major undertakings where well-established precedent has more or less standardized the method of procedure. The treatment of pilonidal sinus justly falls into this category, for I know of few other minor surgical conditions in which the outcome is apt to be so distressing to both the patient and the surgeon.

There are two reasons why the treatment of pilonidal sinus is unsatisfactory: (a) delayed healing; (b) recurrences. Any surgical procedure which is often attended by long and tedious healing and which shows a high percentage of recurrences seems to me to have something intrinsically unsound about it, and therefore deserves serious surgical investigation of the underlying causes.

A consideration of the causes of both delayed healing and recurrences leads us first to the methods now in use in the treatment of pilonidal sinus. In general it may be said that all methods begin with complete extirpation of the sinus and all its ramifications. An hollow cavity is then left which has as its base the sacrum and coccyx with their fascial covering, and at times the proximal portions of the gluteus maximus with its fascia, and side walls of fat. This cavity is customarily treated in one of five ways:

1. It may be left wide open and allowed to granulate.
2. It may be left open and closed later by secondary suture.
3. It may be closed around a drain.
4. It may be closed by mobilizing a flap from the buttocks and drained through the secondary incision.
5. It may be closed tightly.

Having in mind these five possible ways of dealing with the cavity, let us consider some of the problems of delayed healing. It is obvious that a cavity which is allowed to granulate will not heal so quickly as one that is treated by any one of the other methods. Yet I have amazed to find that by and large there is very little difference in the actual healing time between any two of the foregoing methods. If occasionally we succeed in getting primary union in the wound that is closed tightly, it is the exception rather than the rule, and the next few cases will prove it to our own chagrin. Certainly it has been proved to my satisfaction that the surgeon may choose any one of the foregoing operations to suit the individual case and then inquire further into the cause of delayed healing.

These further inquiries will reveal the following possible reasons for tardy healing:

1. Type of patient who has pilonidal sinus.
2. Ill-chosen time for operation.
3. Unavoidably unfavorable location of wound.
4. Imperfect hemostasis at the time of operation.
5. Incomplete excision of the sinus tract and its secondary branches.

It is a well known though not readily explainable fact that the majority of patients with pilonidal sinus are young, obese and hairy individuals, many of whom suggest some endocrine imbalance. From the surgical standpoint this is important in that the layer of fat over the sacrum and coccyx is therefore greatly increased in amount. The resistance to infection in this area is thus reduced to a

minimum and I believe this definitely contributes to the slow healing.

Operating upon a pilonidal sinus at an ill-chosen time often affects the healing period. Unfortunately the surgeon sees most of these patients either when an abscess is impending or has formed already. At this stage we must be content with simple incision and drainage. It is then important that the radical operation not be attempted until the abscess is thoroughly healed. Not a few cases of delayed healing can be attributed to postoperative infection resulting from an operation performed while there was still some purulent discharge from the abscess. The patient often makes this decision difficult because he has become disgusted with the long draining abscess and is inclined to be impatient to rid himself of it, but patience on the part of the surgeon will be rewarded by the result.

The location of the operative wound in these cases is unfortunate for two reasons. First, it is so situated that it can be constantly subjected to pressure and irritation either walking, sitting, or lying; and second, its proximity to the rectum makes it readily accessible to contamination from the colon bacillus. Both of these I feel sure have something to do with delayed healing. It has been possible to overcome these difficulties to a considerable extent by adopting what I call "a pilonidal sinus regime," which may be stated as follows:

1. Appropriate dose of castor oil the night before operation, and a high cleansing enema the morning of operation.

2. Liquid diet and appropriate doses of deodorized tincture of opium, so that the bowels are not allowed to move for at least six days after the operation.

3. The patient lies prone or on the side for at least fourteen days after the operation.

Imperfect hemostasis at operation will result in an hematoma which can greatly retard the healing time. Much of the bleeding comes from the fascia over the sacrum and coccyx, is difficult to ligate, and is controlled best by pressure from dry gauze. No attempt should be made to begin suturing until the surgeon has satisfied himself that the cavity is absolutely dry. If a vessel is punctured while suturing it is best to remove the suture and control the bleeding before proceeding with the remaining sutures.

Incomplete extirpation of the sinus tract obviously will prevent ready healing if healing will occur at all. At times it becomes extremely difficult to know whether or not all of the tract and branches have been thoroughly removed. Injection of the sinus with methylene blue facilitates recognition of tortuous tracts but even with this, difficulties can be encountered especially if the fascia over the sacrum and coccyx is involved. I believe it is wise to remove as much of this fascia as is stained with the dye since infected fascia can prolong healing almost indefinitely.

The causes of recurrences are in a sense more difficult to determine than those of delayed healing and in some instances are identical, but from my observations the most important factors are:

1. Faulty obliteration of dead space at operation.

2. Delayed dead space formation.

3. Failure to remove adequately infected sacrococcygeal fascia.

4. Incomplete excision of sinus tract.

I believe it is highly important to suture these wounds so that all dead space is completely obliterated. Especially is this true of the lower angle of the wound near the coccygeal tip. Through and through sutures of silk or silk-worm gut should be placed first, which include if possible the fascia, and the cavity then obliterated with as many layers of running fine catgut as seems advisable. If a small rubber dam is to be employed, it should never be brought out in the lower angle of the wound. This leaves a drainage tract perilously close to the rectum and invites subsequent infection. What we consider a recurrence is often not a recurrence of the sinus itself, but an infected dead space of fascia and

fat, which eventually breaks through the skin and forms a sinus for itself.

Delayed dead space formation I believe occasionally is responsible for recurrences, especially after some minor trauma to the sacrococcygeal region. Even in a well-healed wound we have nothing but skin, an unstable scar in a deep layer of fat, and bone. With constant pressure as in sitting, or an acute injury, the scar may break first in the fat adjoining the bone which results in a dead space possibly with a small hematoma. The dead space eventually finds its way to the skin and becoming infected presents a picture closely resembling the original pilonidal sinus.

Delayed dead space formation might be avoided if we could successfully interpose muscle between the fat and bone to afford a resilient base for the scar in the fat. It might be possible to turn into the cavity, for example, two butterfly wings of gluteus muscle, one from either side.

But whether or not we like to admit it, incomplete excision of the sinus and its tracts, and inadequate removal of diseased fascia account for a high percentage of recurrences regardless of what type of operation is performed. This can be avoided only by a careful and painstaking dissection of diseased tissue. We have been accustomed to regard pilonidal sinus too lightly and to pay too little attention to its problems and intricacies. To be done well it may often require all the ingenuity and resourcefulness of the experienced operator.

One observation has struck me forcibly and that is the cases that do best are those in the few thin individuals who have pilonidal sinus and who are operated upon before an abscess or virulent infection has occurred. This has led me to believe that the answer to the problem of pilonidal sinus is simply that we do not operate early enough. I believe the key to the solution lies in the hands of the pediatrician, the internist, and the general practitioner. Careful inspection of the sacrococcygeal region in routine physical examinations of children will reveal the slight dimpling, and if the dimpling is patent enough to admit a short probe, operation should be advocated. I believe if the operation were done in childhood when no symptoms are present, and before any secondary infection has developed, we might be able to attain a high percentage of primary union and a low percentage of recurrences. Certainly operation in this symptomless period is justifiable when it is realized that sooner or later trouble will ensue and then possibly at an economic loss that is comparable to many major surgical procedures.

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*Continued from p. 103.

GONOCOCCAL LAPAROTOMY WOUND INFECTION*

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CHICAGO, ILL.

FROM a review of the literature it is evident that the skin and subcutaneous tissues are not the most suitable soil for the development of gonococci. Wertheim,[1] in 1892, injected 0.5 c.c. of a pure ten-day-old culture into the subcutaneous tissue of his own forearm. In a few hours there was a feeling of tension with pain and swelling for a period of thirty hours, but from this time on the local reaction subsided so that on the third day following the injection there remained only a slight amount of sensitiveness. One cubic centimeter injected into a patient resulted in a palm-sized swollen painful area that gradually subsided after the third day. Bumm had reported similar negative results, and came to the conclusion that the gonococci do not multiply in the cutis, that they perish, and that no organisms were present after twenty-four hours if the site of injection was incised. Steinschneider,[2] in 1893, found no redness, infiltration, pus, or pain after injecting organism below the skin of the back.

The subcutaneous tissues may become infected from gonococcal infection of underlying structures, secondary to a blood stream infection, or due to contamination. Wynn[4] in 1905 reported the cases of 2 patients who had this site of infection following Neisserian infections of the underlying joints. Dwyer[7] reported the presence of gonococci in a 2 inch abscess in the subcutaneous tissues of the lumbosacral region. It was thought that pressure played an important part in decreasing the local resistance, thus affording the organisms a fertile soil for their development. Gonococci were cultured from the patient's blood stream and autopsy revealed a perforating mitral valve ulcer.

Kingsbury[8] records the formation of a 2.5 × 1 cm. cutaneous ulcer due to gonococci following a cutaneous abrasion of the right elbow. Stephens[9] observed a second-degree burn where a subcutaneous injection of hot saline solution had been given. The site of injection became ulcerated and its base was covered by thick yellow pus containing gram-negative intracellular diplococci. Smears from the stump amputation and the urethra showed no gonococci. The discharge decreased under treatment with 10 per cent silver nitrate after a protracted course of eight weeks. He felt that the organism was carried into the wound by contaminated instruments. Fulton[10] ascribed an ulcer 1.5 cm. in diameter, of punched-out outlines, discharging a creamy, white, and odorless pus containing gonococci, to the previous incision of a "pimple" by a contaminated knife of a genitourinary specialist.

Lawson and Smithwick[11] recorded the occurrence of gonorrheal infection of abdominal wounds following laparotomy. They reported 2 cases which will be summarized because they are somewhat similar to the one to be reported here.

In the first patient, laparotomy on a twenty-two year old female revealed infected, tortuous, and edematous fallopian tubes. Pus expressed from both contained gonococci on culture. On the fifth postoperative day she had a temperature of 101° to 102°F. Investigation of the wound elicited a bloody purulent discharge from the edematous subcutaneous tissues. Both smears and cultures demonstrated gonococci. No gonococci were found in the urethra or cervix uteri. After three weeks of dakinization and treatment with 10 per cent argyrol the wound healed.

In their second case, laparotomy demonstrated a normal appendix and the pelvis free from fluid, adhesions, or thickened fallopian tubes. Their postoperative diagnosis was pyelitis. However, on the fourth day following operation the temperature rose to 102°F. Examination of the wound showed no visible changes until the eighth postoperative day. At this time there was obtained an abundant bloody serous discharge that contained gonococci on culture. Smears of the cervix uteri in this patient were positive for the organism.

* From the Department of Gynecology of The Post-Graduate Hospital and Medical School. Presented before The Chicago Gynecological Society, March 18, 1932.

In both these patients the authors admit the remote possibility of contamination by indirect infection from the genitalia. They also concede the possibility of infection from dressings or instruments used on other patients who may have had a gonorrheal infection. Nevertheless, it is more probable that the edges of the abdominal incision were infected as a result of direct contact with the infected fallopian tubes as they were being removed from the abdomen. These same factors are also present in our patient, but in addition, the rather marked anemia may have resulted in a local and general decreased resistance. Lawson and Smithwick also conclude that the duration of the infection is apparently shortened by the use of the silver compounds rather than by any of the more commonly and less specific antiseptics used as a wound dressing. In our patient no silver compounds were used and still the wound healed. Adequate drainage must be of considerable importance regardless of what type of antispetic may be used.

CASE REPORT

The patient was a white female, aged thirty-three years, consulted Dr. Emil Ries with the following history: Diffuse abdominal pain accompanied with slight lumbar backache had been present for one week. Anorexia with some loss of weight had occurred during the three to four weeks prior to her entrance into the hospital. Equally important to her was the fact that the last menstruation had commenced eight days before admittance and she had bled so profusely, with passage of large clots, that she complained of dizziness and a headache for three days. Her menses began at thirteen years of age, occurred regularly every month, were moderate in amount, contained small clots of blood, and were associated with some low abdominal pain on the second and third days. A slight amount of yellow vaginal discharge had been present for years but she had noted some increase in the last week. Some frequency of urination and nocturia had been present for some time, but she did not complain of burning or pain on urinating. On the day before entering the hospital she had vomited once after eating and had had a chill.

In her past history the only facts of significance were the presence of a cystitis and pyelitis four and one-half years prior to the present condition. A diagnosis of an abdominal tumor had been made one year previous. She had had one spontaneous delivery five years previous.

Physical examination, upon entrance, revealed an acutely ill, very anemic, restless, thirty-three year old, white female, with temperature 102.6°F., pulse 130 per minute, respiratory rate 28 per minute, systolic blood pressure 106 mm. and diastolic 54 mm. Hg.

With the exception of a herpetic lesion of the lips, the head, neck, breasts, heart, lungs, and extremities were free from significant changes.

The abdomen was rounded symmetrically and tenderness was present in both lower quadrants, but most marked in the right side. Rising from the pelvis was a hard round, tender, and slightly movable mass, that extended two fingerbreadths above the umbilicus.

Vaginal Examination: No pus was present in the urethra or labial glands. The cervix uteri was bilaterally lacerated, and the os had a diameter of 1 cm. The mass felt from above was found to be connected with the uterus. The appendages could not be palpated.

Laboratory Examination: The urine contained a few leucocytes and a trace of albumin. The blood showed 3,290,000 erythrocytes, 14,100 leucocytes per cubic millimeter, of which 87 per cent were polymorphonuclear leucocytes, and the hemoglobin reading was 50 per cent. The blood Kahn and Wassermann reactions were negative.

Preoperative course of nine days after admission: The abdominal pain, vomiting, and vaginal bleeding gradually subsided after conservative treatment. However, the leucocyte count rose to 21,150, the hemoglobin reading remained at 50 per cent and the erythrocyte count rose to 3,860,000 per cubic millimeter, and contained many macrocytes and microcytes with marked achromia, poikilocytosis, anisocytosis, and polychromatophilia. Also profuse sweats occurred daily. After the second day of hospitalization most of the abdominal tenderness was confined to the right lower abdominal quadrant.

Operation: Laparotomy by Dr. Ries on the tenth day after admission and seventeen days after the onset of the abdominal pain, revealed a 14 × 16 × 12 cm. uterus containing a 12 cm. intramural fibroid. Numerous wide and tortuous veins coursed below the

surface and were also present in the broad ligaments which the uterus had invaded. The uterus was adherent to the anterior parietal peritoneum by thin fibrinous adhesions. The fallopian tubes were free but very red and fully one and one-half times their normal thickness in their distal half. Segments of the ileum in the lower half of the abdomen were the site of pale yellow patches of fibrinous material. The appendix was irregularly covered by a 1 mm. thick dull yellow exudate.

The supravaginal portion of the uterus, both fallopian tubes and ovaries, and the appendix were removed. After the intra-abdominal surgery was completed, clean instruments, gloves and linen were used in order to prevent infection from being carried from the pelvis to the edges of the wound.

Essentially, microscopic examination showed a fibrinopurulent exudate on the surface of the appendix and ovaries. A similar exudate was present on the fallopian tubes but their lumens contained a purulent exudate which was also present between the circular muscle bundles. The central portion of the intramural fibromyoma showed occasional small foci of polymorphonuclear leucocytes and plasma cells. The endometrium was thick, contained occasional dilated glands, some of which contained leucocytes and the stroma was edematous with a moderate number of leucocytes, lymphocytes, and plasma cells, with small foci of hemorrhage near the surface.

Postoperative Course and Findings. The temperature decreased gradually from 102° to 99°F. with a concomitant decrease in pulse rate to 96 until the seventh postoperative day when the temperature rose to 102.2°F. with the pulse to 110 per minute. The profuse sweats continued. Examination of the wound on this day revealed no discoloration or abnormal tenderness but when two sutures were removed and the lower end of the median incision opened a large amount of pale brownish, pea soup like liquid escaped. Smears and cultures on Herrold's media revealed morphologically and culturally characteristic gonococci. No growth was obtained on the ordinary media. Similar organisms were obtained from the discharge of the cervix uteri and vagina on the tenth postoperative day.

No local or "specific" therapeutic procedures were resorted to until the sixteenth postoperative day in order to obtain adequate bacteriological evidence of gonococci.

All sutures including the deep tension sutures were removed on the eighth postoperative day in order to obtain adequate drainage.

From the opening made at the lower end of the incision a 1 × 1 cm. piece of grayish necrotic tissue was expressed on the tenth postoperative day.

Undermining for a distance of 1 to 2 cm. on each side of the lower 2.5 cm. gap was elicitable on the twelfth postoperative day, but the underlying fascia was intact. On this day a 1 cm. gap in the incision was present 3 cm. above the previously formed opening. These two communicated with each other. The complement fixation test for gonorrhea was positive.

On the sixteenth postoperative day, after bacteriological confirmation had been obtained, administration of gonococcus vaccine was resorted to daily by the intramuscular route.

On the eighteenth postoperative day four communicating gaps were present along the incision but the underlying fascia was intact.

On the nineteenth to the twenty-third postoperative day, balsam of Peru was poured into the equidistant gaps of the wound. The edges of the wound gaps became pink and the openings decreased in size. On the twenty-seventh postoperative day the small amount of clean serous discharge was free from organisms.

On the thirty-second day following the operation, and sixteen days after the institution of any local or specific treatment, the patient was discharged.

The wound was found to be healed on the forty-second day and again at this time there was no pus obtained from the urethra or labial glands.

When seen five months after the operation the wound was solid, there were two small puckered 1 cm. scars in the lower and middle thirds, no evidences of hernia were present, the fascia was solid, and the cervical stump was freely movable.

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NEW INSTRUMENTS

RECEPTACLE FOR COLLECTION OF BILE

WHEN PROLONGED DRAINAGE IS REQUIRED

JOHN M. MCCAUGHAN, M.D.

ROCHESTER, MINN.

A SIMPLE, efficient and inexpensive collecting apparatus for use when prolonged biliary drainage is required can be constructed from materials readily available in any hospital supply room (Fig. 1). An ordinary glass medicine bottle of suitable size is fitted with a Davol rubber bottle top which must be perforated with two holes; one is for reception of the biliary drainage tube and the other is a pin hole or air vent, to permit displacement of air as the bottle gradually becomes filled with bile. This type of receptacle has the chief advantage of preventing spilling or leakage of bile. It is therefore of use in treatment of the patient who is ambulatory, as well as in the care of the patient who is confined to bed, inasmuch as any reasonable degree of bodily activity is permitted without risk of soiling dressings or bedding with bile. Furthermore, the entire collecting system can be kept free from contamination with but very little effort. Because of the viscosity of bile there is little danger of its escaping through the air vent when the bottle is turned wrong side up. The bottle should be emptied regularly by a nurse, and never allowed to become completely filled. This type of receptacle has been used in several cases, and has been found very satisfactory.

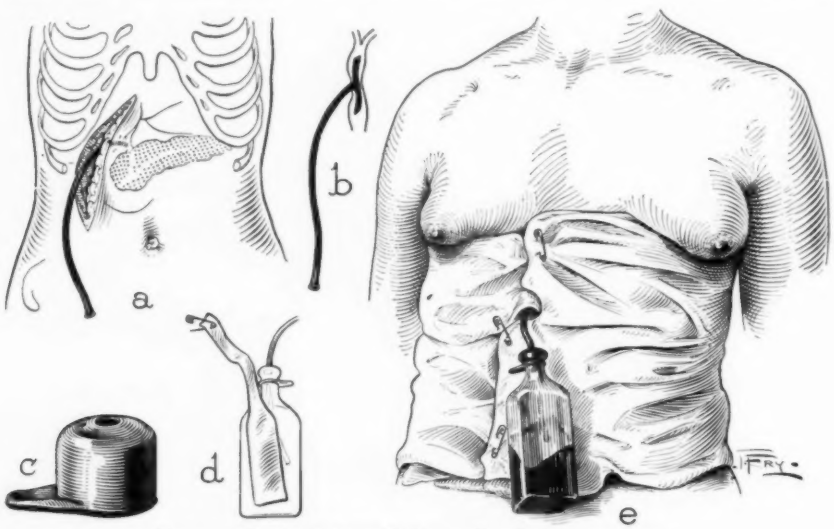

FIG. 1. Method of applying collecting apparatus.

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EDITORIAL

TRAUMATIC SURGERY OF THE FUTURE*

EVERY surgeon in every specialty has had a dream in regard to measures and apparatus applicable to his particular specialty. In that branch of surgery allocated to traumatic surgery apparatus plays a great part, and, hence, the paraphernalia for practicing this type of surgery has always been diverse. I have always believed that traumatic surgery was a specialized branch of general surgery and that this special type of surgery could be best practiced by those who had previous training in abdominal, thoracic, cranial and other types of surgery.

Paradoxical as it may seem, traumatic surgery is only just now beginning to attract the attention it deserves, and in every hospital and in every community accident cases are demanding and receiving a higher grade of care. It is only a question of time until the various hospitals will segregate this type of surgery to groups of men who are specially interested in it. The day has gone by when a broken limb can remain unattended for hours and even for days, and I have always maintained that a broken bone should be subjected to the same type of emergency treatment as a broken appendix.

It is paradoxical also to reflect that in ancient days traumatic surgery was the only type of surgery that was practiced, and equally paradoxical to learn that the history of medicine abundantly shows

* From the Dept. of Traumatic Surgery, New York Post-Graduate Medical School, Columbia University and Reconstruction Hosp. Unit, Presidential Address, Association of N. Y. & New England Railway Surgeons, November 11, 1932.

that in the days of the pyramid builders, even as now, broken bones and wounds were extremely common. As a matter of fact, the first operation of which we have any accurate record was a bone-graft out of Adam into Eve, and so far as the history states, no electrically driven bone-saw was used.

If we had some magic wand or some magic carpet by which we could project ourselves into the future, what would we as traumatic surgeons ask for? First, I think we would like to have some anodyne to relieve pain, something that could be given in tablet or capsule form which would have no after effects and which would not dry up the normal secretions and which would not be habit-forming and would not cause any special reaction. Imagine the boon this would be to a seriously injured person and how helpful it would be in the case of children badly burned. You known and I know the horror incidental to the care and treatment of a badly burned child, and what a grateful thing it would be if we had at our disposal some super-anodyne that would be universally efficacious without doing damage, even to an infant. Next, I would like to have some sort of human glue that would make it unnecessary for me to use sutures to coapt wounds. I would like to have this applicable for fractures also so that when bone ends were exposed an application of this glue would effectively seal them so that no other form of retentive apparatus would be necessary. It is said that the Ancients had such a glue, and it does seem in this day and generation that we ought to be able to provide ourselves with an effective remedy of this sort. I would like to have also a portable emergency *x*-ray apparatus that I could tuck away in my bag and plug it into any electric light receiver, and I would want it to be effective enough to delineate soft parts and be absolutely free of any danger to my patient or to myself. I would like to have also some automatic film which would be self-developing so that all I had to do would be to focus and press the button and after a few minutes my radiographic print would be ready for inspection. I would like to have also what the Ancients sought for just as we have, namely, some universal antiseptic which could be given to the patient immediately at the onset of an injury or after its receipt. This *sterilisia magna* has been a dream of surgeons in every generation and eventually it will be found, and I feel reasonably certain that it will take the form of some agent that will change the local reaction of the tissues so that it will be impossible for organisms to grow in that particular location.

It seems to me that the route to wound salvation is along this horticultural pathway. We known that it is impossible for a certain sort of soil to propagate certain sorts of plant life, and I feel sure that we will have at our disposal some kind of an irrigating medium that will make it impossible for certain types of germ life to propagate in areas where we do not wish them to propagate.

Antiseptics of today are less regarded than ever, and the old clinical axiom is again becoming manifest, to the effect that any antiseptic capable of killing the organism is also capable of killing the tissue. In other words, the germs are stronger than their host and they will outlive the tissues in attempts at destruction.

I would like to have also some simple test for organisms so that I could take a swab of a wound and put it in some sort of a special test tube and lay it on my office desk and in a few hours have a growth so typical that I could determine there and then whether I was dealing with a streptococcus or a staphylococcus or a colon type of infection. I would like also to have some means by which certain organisms as yet unknown could become demonstrable, and perhaps this will be brought into the realm of probability by way of a super-microscope or some dye which will have a selective action on organisms, of whose exact type and nature we are now in ignorance.

I would like also to have some definite means of preventing and controlling osteomyelitis which from a prognosis standpoint I regard as analogous to cancer, and I strongly subscribe to the old surgical

axiom: Once an osteomyelitis always an osteomyelitis. The two prevalent forms of treatment for osteomyelitis, namely, the Orr treatment and the maggot treatment, are but phases of treatments for this disease. The Orr treatment is the outcome of the Bipp treatment which was used in the British Army during the war, and it received the name because after débridement of the wound a paste was applied consisting of bismuth, iodoform, and petrolatum paste, and thus the initials of these materials gave the name. There is no virtue in the Orr treatment beyond other forms of treatment except in so far as débridement is performed as a preliminary and thereafter a surgically clean wound is left alone and there is thus no chance for its re-contamination by non-aseptic dressings. The maggot treatment would never have been heard of had it not been advocated by a man so well known as the late William Baer of Johns Hopkins. Dr. Baer was a lovable character and a man of great experience and his advocacy of the method gave it a vogue that has lasted up to the present time. I think it is a far cry from the Carrel-Dakin treatment to the maggot treatment, and if we are to proceed along that line, the next step will be to breed rats to get rid of a city's garbage, and it is only one jump more until we return to the use of a chew of tobacco and cobwebs for wound treatment!

In connection with the cure of osteomyelitis I am hoping that there may be developed some drug that will have a selective action toward diseased bone. This will be similar to uroselectan, and I believe that it is only a question of time until a medium of this sort becomes available.

I would like to have some new kind of plaster-of-Paris which would obviate the present disadvantages of this important material. We are using practically the same sort of plaster-of-Paris now as they used after the Civil War when it first came into general use, and there does not seem to be any good reason why a lighter and more workable form could not be devised.

I would also like to have a more accurate means of making a diagnosis of systemic diseases by the application of some radio apparatus or the photo-electric cell so that the latent electric energy of the liver, heart and other organs might become manifest externally. It does not seem too much to hope that eventually we will have the diagnosis of heart, kidney, liver, brain and splenic diseases interpreted through some sort of a device that will register the abnormal after we have determined exactly what is the normal. A registering device of this sort is used for manifold purposes in industry, and some inventive genius will aid us in making use of it as a diagnostic agency.

I would like to have also some means by which damage to the spinal cord could be corrected and I have never wholly subscribed to the idea that the spinal cord is the only tissue in the body which will not regenerate when it is severed or seriously damaged. I do not believe that this is absolutely true, and some day this tragic group of cases will become more amenable to treatment when we find some means of grafting or bridging a damaged spinal cord.

Lastly I would like to have some means for accurately determining the reality of pain and I know that a "pain detector" would be of great advantage in many traumatic and non-traumatic conditions.

Now some of these things may seem fanciful and too futuristic, especially in this day of depression, but I firmly believe that traumatic surgery is the surgery of the future and that within the coming years we will make as many important advances as were made in the early stages of the development of abdominal surgery. Surgeons of experience are realizing that this field of traumatic surgery has been neglected too long and they are giving their attention to it and bringing to bear the abundance of their experience in other types of surgery. The injured are now receiving a grade of care and attention far and away better than they received ten years ago, and in the years to come my belief is that an accident case will be dignified by as much surgical attention and refinement as an abdominal case. Certainly a fracture of a femur in an adult is entitled to just as much specialist care as tonsils and adenoids in a child.

John J. Moorhead, M.D.

JAMES DOUGLAS

JAMES DOUGLAS, one of the most interesting medical men of Canada, was born in Scotland in 1800. He began his training as apprentice to a "surgeon and apothecary." He then went to Edinburgh where he became a pupil of Robert Liston. When eighteen, he signed as surgeon to a whaler on a trip to the Arctic circle. He got his license from the Royal College of Surgeons of Edinburgh. In London he studied surgery at Guy's Hospital under Ashley Cooper and at St. Bartholomew's under Abernethy. He then made a trip to India, again as a ship's surgeon.

He next joined a part of English settlers colonizing on the Mosquito Coast. Sickness broke out and Douglas was taken unconscious aboard a ship and carried to Boston. After he recovered he moved to Utica, N. Y., married and began the practice of medicine. Detected in an unfortunate body-snatching incident, he moved to Quebec, where he opened an office. While waiting for patients he taught anatomy, first in his house and later in a building granted for his work. In 1831 Douglas took charge of the surgical patients of the Marine and Emigrant Hospital, which under Douglas' supervision became a splendid school of practical surgery. We read that in these pre-inhalation anesthetic days he "removed the lower jaw of a hypnotized patient without causing any pain."

In 1832 Asiatic cholera swept Europe. The Inspector of Military Hospitals in Canada asserted that it could not cross the ocean. Douglas publicly questioned this stand and advertised that the disease would strike Canada during the summer of 1833. It did. In 1847 Douglas rented a house at Beauport for the reception of private patients with typhus. Douglas also did pioneer work in the housing and care of the insane.

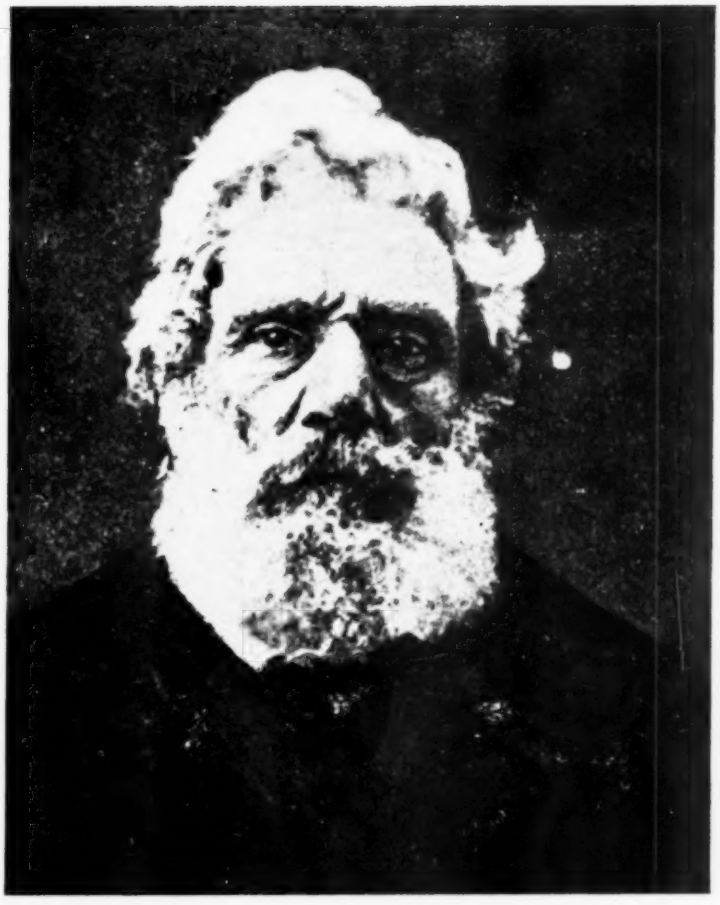
Douglas was a big man with a domineering personality backed by a deep bass voice. His hair was thick and he wore full whiskers with a heavy mustache. He was an ardent fisherman. He earned large sums of money but invariably lost it in bad investments.

The last eleven years of his life were spent with his son at Phoenixville, Pa. He died at the age of eighty-six, in 1886.

T. S. W.

NOTE

The Journal wishes to acknowledge the previous publication of the portrait of William Beaumont which appeared in the March, 1933 issue in the Biographical Brevities section. This portrait originally appeared in Myers' Life and Letters of William Beaumont, St. Louis, Mosby, 1912.



JAMES DOUGLAS

[1800-1886]

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE EVOLUTION OF HERNIORRHAPHY

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FOREWORD

THE nature of this article precludes any attempt at an exhaustive recital of the countless methods which have been advocated for hernial repair. Such a work would require volumes. Throughout the development of surgery, no subject has received more comment than that of hernia. Relatively few cures were effected by the early operations and each successive generation of our medical forebears devised its own means for dealing with the condition. Some of these were advances, most of them were old procedures with only minor variations in technique to suit or identify their particular sponsor.

To chronicle all of these variations would serve little purpose except as an insight into the capabilities of the particular operator. Of more interest surgically is just how the problem of hernia was dealt with technically in light of the knowledge and means of the various periods. It is from this angle that we propose to discuss the subject with emphasis on the technical evolution of herniorrhaphy rather than on the character and accomplishments of those who brought about that evolution. In so doing we pass over rapidly or omit entirely many operators who exerted great influence in other fields but who did little to alter or improve the treatment of hernia.

Little attempt has been made in this review to translate original manuscripts. Standard works of medical and surgical history have been freely used and with few exceptions the foreign material has been taken from English or French translations.

A chronological sequence of the methods of hernial repair is logical. But as will be seen, these methods overlap frequently and in some instances revert back to an entirely different age. In general, each early operator dealt with all types of hernia in the same manner. As hernias in the region of the groin were not differentiated accurately until quite late in medical history, our descriptions will be those for inguinal hernia unless otherwise stipulated.

EGYPTIAN AGE

In the translations of the several papyri dealing with the medical knowledge of Egypt[1] it is rather disappointing not to find adequate descriptions of hernia. That this malady frequently had to be dealt with cannot be doubted. However many

of the descriptions which pass for those of scrotal hernia might fit equally well for hydrocele or varicocele. Practically no attempt was made at anatomical diagnosis though the clinical pictures described are quite vivid and in many cases leave little doubt as to the true nature of the condition. Occasional complete descriptions of intestinal obstruction are noted. One of these from the Ebers Papyrus, " . . . a person who suffers from an obstruction in the abdomen and thou findest that it (tumor) goes-and-comes under thy fingers like oil in a tube . . . " and " . . . a skin tumor on the outside of the body above his genitals" is most certainly that of an incarcerated inguinal hernia.

In general the treatment of acute intestinal obstruction and hence incarcerated hernia, consisted in cathartics and hot applications to the abdomen. This kill or cure method must have taken a heavy toll and its divergent results added greatly to the mystery of the true condition at hand. Egyptian Surgery did not include opening the abdominal cavity. However this procedure was carried out by the Hindus in a period which overlapped the ancient civilization of Egypt and Greece (1500 B.C.–700 A.D.). Nothing is known about the Hindu technical methods except that the abdomen was occasionally opened, obstructions relieved and at times intestines sutured.

The treatment of simple hernia by the Egyptians consisted in applying snugly fitting bandages to the region in an attempt to maintain reduction or give support to the large scrotal type of hernia. If the same skill was used in applying these as that demonstrated in the bandaging of mummies it is fair to assume that this method produced quite an effective form of truss. It is probable that hydrocele and numerous afflictions of the testes were treated in a similar manner.

GREEK AND ROMAN PERIOD

The older Greeks, though careful clinical observers, possessed little anatomical knowledge. As a result they added little to the treatment of hernia then used along the opposite shores of the Mediterranean. For intestinal obstruction which might be caused by an incarcerated hernia they continued with the use of cathartics and added a more popular treatment, the clyster. Of this latter procedure frequent mention is made in the works attributed to Hippocrates and the suggestion is also given that this failing an attempt should be made to inflate the bowel by rectum using a pipe and bladder. At times such bowel strangulation proceeded to an ulceration through the lower abdominal wall forming an enterostomy with a "fetid discharge giving a poor outlook." Toward the middle of the Greek era reduction by traxis was added as a treatment for strangulations (Praxagoras of Cos, *circa* 400 B.C.). Soon after this period, surgery started on its somewhat devious course to the present solution of the problem of hernia. Surgery including the cautery became accepted forms of treatment.

No records remain of the actual technique of Greek hernial repair. Accurate descriptions are however preserved in the works of some of the Greek physicians who migrated to Rome. Our most complete descriptions are those of Celsus (25 A.D.). He followed closely the work of Asclepiades of Bithynia (124 B.C.), the founder of Greek medicine in Rome. The methods of hernial repair used by Celsus will be taken up in detail as they formed much of the basis for operative procedure until the nineteenth century.

Celsus gave some very good descriptions of the contents of hernial sacs and contrasted them with hydrocele. The relation between the scrotum and the abdominal cavity however was not appreciated. It was thought that the testicle was in some way responsible for the rupture and consequently it was removed at operation. In his treatment of hernia Celsus advocated the following: (1) preoperative treatment consisting of one to three days' fast followed by a clyster; (2) incision over lower inguinal region and upper scrotum carried

down to hernial sac; (3) margins of wound held apart by two skin hooks and sac isolated from its surrounding structures; (4) sac opened, care being taken not to injure testicle or intestines; (5) if the patient was a child the testicle was removed but in a "robust man" it was again dropped back into the scrotum; (6) intestines reduced and held so by several sutures in base of sac and adjacent tissues; (7) if a small portion of the omentum was present in the sac it might be safely reduced but if large it was transfixed by two ligatures and the distal portion excised; (8) vinegar dressing applied and wound usually left open to granulate. Occasionally, loose interrupted skin sutures were inserted; (9) At times strips of skin were excised from the wound margins so as to bring about more extensive granulation and hence a heavier scar to repair the defect; (10) Long ends of ligatures were allowed to protrude from the wound; these came away "easily without pain or hemorrhage when suppuration was well established." The aponeurosis was not incised in any of these older operations.

Celsus did not use the cautery to any extent and obtained hemostasis by means of linen ligatures. He did not operate upon strangulated hernia "where the flesh is hard and the tumor does not reduce." Instead, poultices to the abdomen, supine position, bleeding and clysters were advocated. Celsus also advised against operation of older people where the condition was far advanced. In children he reduced the hernia and attempted to effect a cure by means of snug bandages. Only after the failure of these, was operation advised. A typical repair of the period and one most likely to achieve success is that illustrated in Figure 1.

Celsus described three methods of umbilical hernia repair. Of these he preferred and used the third method listed below. (1) After dissecting out the sac, two sutures on a needle were passed through the base of the empty sac. One of these was tied on either side thus allowing the tissue above to mortify. Healing was by granulation. (2) Same as above except that sac was opened and intestine pushed back into the abdomen with the examining finger before sutures were inserted. (3) With the patient standing a line was traced on the skin about the base of the hernia. Then with the patient supine and the intestine reduced, the sac was pulled out and a strong suture passed around its base at the site of the tracing. The portion of the sac above the ligature was cauterized and the wound allowed to granulate.

The postoperative care of this period consisted of rest in bed for approximately one month, local treatment of the inevitable suppurating wound and a mysterious dietary regimen to satisfy the whims of the operator. Needless to say the success of these repairs would depend largely upon the amount of firm scar tissue resulting from the healing process. This fact was well known by our ancient masters.

MIDDLE AGES

With the disintegration of the Roman Empire and the loss of all strong centralized government, the well-advanced art of surgery sank to a level from which it did not recover fully until the sixteenth century. During this period but few operators approached the degree of technical perfection attained by the later Greeks and Romans.

Paul of Aegina (625–690 A.D.) was the last of the Greek School to add anything of value to the operative cure of hernia. This worker followed very closely the methods used by Celsus but modified them to suit his own originality and at times to the betterment of the operation. In the repair of early or small hernias he advised the following practice: (1) dissection of the sac from its surrounding tissues, cord and testicle, leaving the latter intact; (2) inversion of the sac into the peritoneal cavity by means of a probe; (3) suture of the base of the inverted sac and withdrawal of probe thus leaving peritoneum unopened; (4) postoperative care consisting

of local dressings of oil, wine or vinegar to the wound. The patient was kept in bed for an unspecified length of time.

ink or the testicle was lifted over the pubis and a similar outline made. (2) The patient was put on a table and the hernia

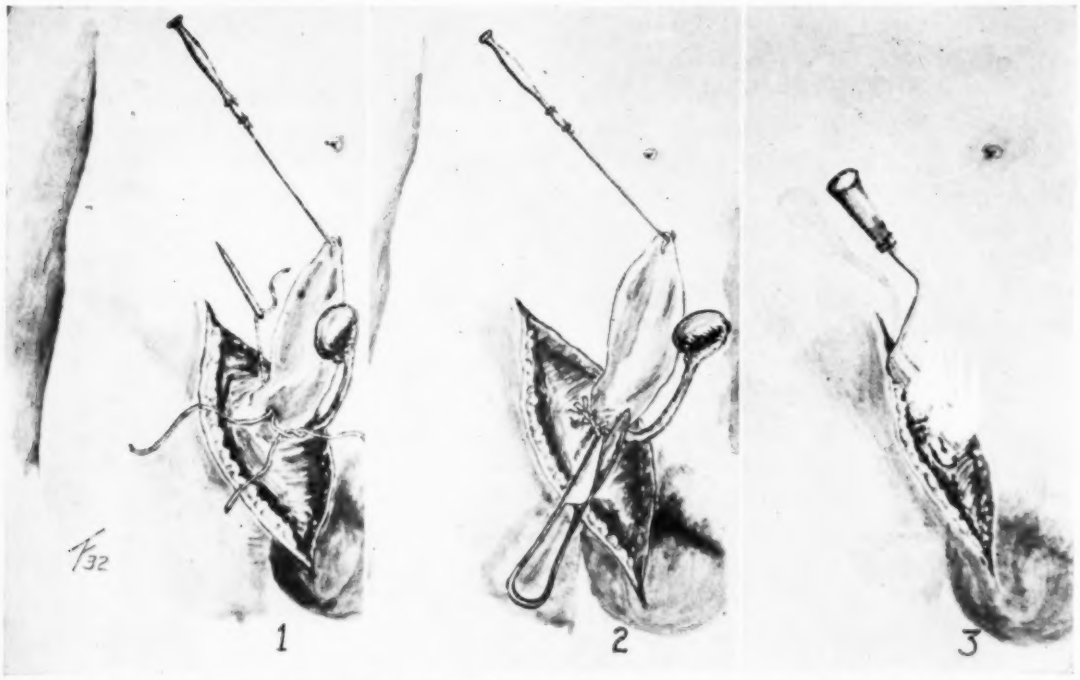

FIG. 1. Hernial repair used by contemporaries of Celsus (25 A.D.). Its use was continued with slight modification well into 19th century. (1) Exposure of sac projecting beneath external ring with ligatures in place. (2) Ligatures tied, one on either side of sac and fundus excised with cord and testicle. (3) Cauterization of entire area. Healing by granulation.

Paul occasionally used the cautery to effect a cure as did Celsus. Generally the testicle was removed at operation. This was partly because it was believed to be one of the causes of hernia and partly because it usually became infected by the operation, sloughing out later and thus delaying convalescence.

By the end of the fourteenth century there were six recognized methods of hernial repair. These, in addition to the ever-present bandages, poultices and drugs were as follows:

(I) *Modified Method of Celsus*, illustrated in Figure 1.

The sac was dissected to its base, ligated and the testicle removed. (Advocated by Roger, 1170–1240; Theodoric, 1205–1252; Guy de Chauliac, 1300–1368.)

(II) *Use of Actual Cautery*, Figure 2.

(1) With the patient standing, the hernial swelling was outlined at its base in

reduced. (3) The outlined area was cauterized until close to the os pubis, care being taken not to injure intestine or testicle. (4) The wound was treated locally and the usual dietary regimen administered. In general the diet consisted of small amounts of simple food and large quantities of wine and water. Following the foregoing procedure Albucasis (1013–1106) kept his patients in bed for forty days and then allowed forty days slow convalescence. The closing of the inguinal canal and strengthening of the abdominal wall again depended upon the resulting cicatrix. (Method advocated by Albucasis, Roger, Theodore, and Guy de Chauliac.)

(III) *Use of "Coutere Potentiel."*

This method was identical with that of the actual cautery except that strong caustic or acid was used to cause a cicatrix instead of the hot iron. The extent of the lesion thus formed by this method could

not be well controlled and it was not in favor with most of the operators. (Advocated by Theodoric and Lanfranc, down to the pubic bone. The testicle was not removed at operation. Healing was by granulation. (Advocated by Lanfranc.)

Fig. 2. Treatment of hernia by actual cautery, (300 B.C.—18th century). Use described under second method of cure in Middle Ages.

Fig. 3. Cure by ligature (11th to 19th centuries). Use described under fourth method of cure in Middle Ages.

(–1315).

(IV) *Cure by Ligature, Figure* 3.

(1) Through a small incision in the region of the rupture a ligature was passed around the base of the sac just above the os pubis. (2) The contents of the sac were reduced. (3) The ligature was tied to a small piece of wood and tightened each day until it cut through the sac, fascia and muscle which happened to be included. It was hoped that this procedure would seal off the sac with scar tissue. (Advocated by Roger.)

(V) *Ligature and Cautery.*

(1) The incision was made over the lower inguinal region and upper scrotum, the sac being dissected free from the surrounding structures. (2) The ligature was tied tightly about its uppermost base and the remainder of the sac dropped back into the wound. (3) The sac was cauterized well

(VI) *Use of Gold Thread.*

(1) Through an incision parallel to the cord, the base of the sac was dissected free from its surrounding structures, testicle and cord being left untouched. (2) The contents of the sac were reduced. (3) Gold thread was then tied around the base of the sac and left there for the wound to heal over it. This method merely occluded the sac at the external ring. (Later termed the "Royal Operation" as it preserved the manhood of the King's subjects.)

With the inevitable suppuration which followed every operation it is no wonder that a fascial layer repair was not attempted. In this connection we should mention four men who held to the then untenable belief that a surgical wound did not have to heal by suppuration and should heal by first intention. These were Hugh, Theodoric and de Mondeville in the thir-

teenth century and Paracelsus in the sixteenth century. All were strong and independent thinkers but formed a very small minority. Had their principles prevailed, our subsequent surgical history would have been quite a different story.

FIG. 4. Hernial clamp of type used by Pierre Franco (16th century). Instrument was applied as indicated and sac with cord excised. Remaining stump was then cauterized and occasionally sutured to prevent evisceration.

SIXTEENTH TO NINETEENTH CENTURIES

From the sixteenth to the middle of the nineteenth century little of lasting value was added to the technical methods of herniorrhaphy. Modifications of former operations and ingenious instruments designed to facilitate these manoeuvres were as numerous as the hernia healers themselves.

The operation for the release of the constricting fascial ring in strangulated hernia was advocated by the Spanish School in the early sixteenth century. Whether to operate in these cases or allow them to proceed to gangrene, abscess and artificial anus was to be an argued point for the next two hundred years. In that early period no doubt the latter procedure carried with it a lower mortality than the former.

The number of diverse operations speak for themselves in indicating the success of any one. It is easily understood why the prospective patient looked with more than skepticism upon the advisability of radical repair of hernia. That this skepticism had a real basis is indicated by the constant advice of our ancient operator as to the avoidance of many pitfalls and an occasional reference dealing with the mode by which the patient could be securely tied to the operating table.

Into this period of doubtful procedures and with few exceptions operators of questionable ability came Ambroise Paré (1510–1590). This worker not only advised against operation for hernia in the majority of cases but devised and made numerous trusses for its treatment.[26] Although the truss was old in principle Paré was the first to popularize its use. Later Pott (1714–1788), B. Bell (1749–1806) and Richter (1742–1812) subscribed to the use of the truss. These men also made notable contributions to the general anatomical knowledge of hernia. Other advances were made by Gimbernat (Anatomy, 1790), Scarpa (1752–1832) described the sliding hernia and Sir Astley Cooper (1768–1841) demonstrated that herniation was the result of failure in the structures of the internal ring rather than failure of the peritoneum and external ring.

Before passing on to our modern period it is well to take brief stock in the statis of herniorrhaphy from 1850 to 1880. The advisability of operation for radical cure was open to question and was not accepted by the medical profession in general. Because of the uncertainty of operation many of the most prominent surgeons advised against it and advocated the use of the truss. The technical procedures were but little modified from those previously described. The best of these was probably that of Czerny (1877) in which the sac was pulled down through the external ring and ligated as high as possible. The pillars of the external ring were then sutured snugly together.

During the first half of the nineteenth century the use of a chemical to produce the desired cicatrix was frequently employed. The most popular procedure of this type was that of Gerdy (Fig. 5).

Cauterization by the actual cautery lost its vogue and was used but little during this period. The "Gold Thread" operation ing and great care was exercised in this matter. The medication varied from cold water to all known mixtures of various

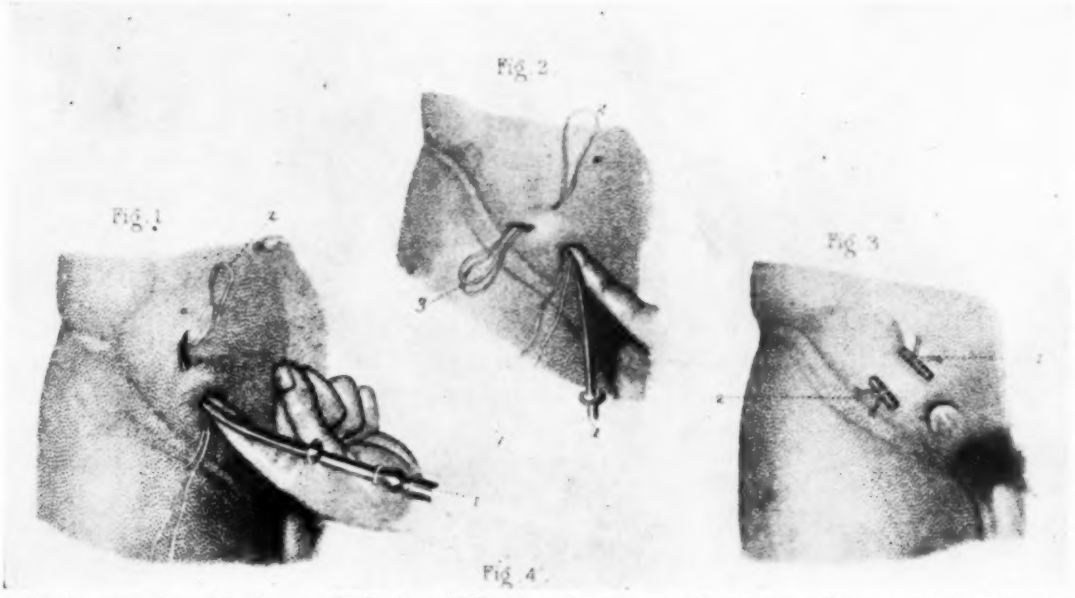

FIG. 5. Gerdy operation. Used extensively in middle of 19th century. Illustrations show method of invaginating fold of skin into inguinal canal where it is sutured. Ammonia or strong irritant then introduced into this fold resulted in inflammation and necrosis. Hernial cure depended upon this process and resulting scar tissue. (After Smith, Operative Surgery, 1852.)

of the Middle Ages whereby the sac was ligated through a small inguinal incision gave way to the "lead wire," "silver wire" and "ligature" methods. In these the above materials were merely substituted for the original gold thread.

For the most part operations were performed through straight linear skin incisions. However other types that were used include the "L" shaped incision, crescent incision and the inverted "T" incision of Dupuytren. The wounds were closed with "sticking plaster" applied to the skin or by interrupted sutures which later were removed "as indicated by the inflammation" resulting from the operation. The suture material included silk, catgut, parchment, various animal tendons, buckskin, kid, silver and lead.

Upon the wound was placed gauze or a sponge from which the "sand and foreign matter" had been removed. Proper healing was considered to be the result of the particular medication applied to the dressointments. The particular type and form of the dressing was considered the "real test of a surgeon's skill."

MODERN PERIOD

With the advent of antiseptic and aseptic surgery the last barrier was removed to accurate fascial plane repair. Before this, any such attempt would certainly have gone down in failure before the ever-present suppuration. The first endeavor directed along the lines of our present-day operations was that of Marcy (1881) in which the aponeurosis of the external oblique was incised to allow a high ligation of the sac, the aponeurosis being resutured to the free margin of the inguinal ligament. This same procedure was executed by Lucas-Championnière (1885). Next appeared Macewin's operation (1886). This worker after careful dissection folded the sac back and forth upon itself several times and sutured it just internal to the internal inguinal ring, thus forming a protecting

peritoneal pad beneath the abdominal wall defect. The aponeurosis was then overlapped above this and sutured to the free margin of the inguinal ligament.

In the year 1888, Bassini reported his hundred cases of "Radical Cure of Inguinal Hernia" and described his operative method. This consisted of opening the external aponeurosis, free dissection and high ligation of the sac, transplantation of the cord above the internal oblique which was first sutured to the shelving margin of the inguinal ligament and suture of the aponeurosis again to the free margin of the inguinal ligament. Bassini's technique to a great extent was to replace all others. It became the more or less standard procedure for indirect inguinal hernia and has remained so to the present day.

A great many operators have suggested modifications to the Bassini operation. Among the earlier ones were Bull and Coley (1890) who described a careful dissection with suture of the internal oblique and aponeurosis to the inguinal ligament over the cord. This became the accepted treatment of cases with undescended testicle and short cord. Wölfler (1892) suggested the reenforcement of the inguinal region by incising the anterior sheath of the adjacent rectus and suturing it to the inguinal ligament. The most notable modification was the extra-aponeurotic transplant of the cord advocated by Halsted (1889) and Andrews (1895). In this method the internal oblique and aponeurosis were sutured to the inguinal ligament overlapping each other underneath the cord. Although at first abandoned this is now the best recognized means of dealing with direct inguinal hernia.

But one more phase remains to be cited in our account of herniorrhaphy. This is the use of fascia in recurrent or old ruptures which require the repair of large defects in the abdominal wall. As early as 1901 MacArthur[11] suggested using a strip of fascia taken from the aponeurosis of the external oblique and interweaving it in the muscle and fascia of the weakened area. This procedure however was discarded until 1921 when Gallie and LeMesurier popularized the use of living fascial transplants in extensive hernial repairs. They used strips of fascia taken from the fascia lata of the thigh. These were interlaced between the internal oblique and the inguinal ligament, also between the aponeurosis and the inguinal ligament thus strengthening the weakened wall at this point. Fascial transplants have found especial use in the repair of umbilical or large incisional hernias. In this connection it might be mentioned that the technique in the repair of hernias other than the inguinal type have followed in the footsteps of their leader with the use of careful dissection and overlapping fascial and muscle repair.

It is interesting to speculate on what changes the future may hold for herniorrhaphy. Has the last important chapter on this subject been written? Living constantly in the present we are most likely to believe that it has and that the ultimate has been reached in our modern anatomical repairs. Yet, with a glance backward at the many peaks already passed we can not but feel that there must be some quite large ones still ahead.

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[For Remainder of References see Author's Reprints.]

BOOK REVIEWS

NONTRAUMATIC SURGERY. The Practitioners Library of Medicine and Surgery, Vol. IV. By Theodore S. Moise, Jr., M.D. N. Y., D. Appleton & Co., 1933.

Volume IV of this splendid system covers Nontraumatic Surgery. This is a new classification which, according to the Preface, was found advisable by the Editors.

There is a discussion of local infections, neoplasms, and general and glandular surgery together with congenital defects, infections, tumors and many miscellaneous conditions. The list of contributors is an interesting one, particularly because it is made up largely of "new" names and not a repetition of the same names that we have become used to as writers on the subjects. The illustrations are ample, well chosen, and well reproduced. The arrangement of the articles is thoroughly practical and the volume is well indexed.

Volume IV confirms the impression created by the first three volumes, that this is one of the most practical systems on medicine and surgery on the market today.

LIGHT THERAPY. By Frank Hammond Krusen, M.D. Foreword by John A. Kolmer, M.D. N. Y., Paul B. Hoeber, Inc., 1933.

Dr. Krusen has written a short practical book on Light Therapy. Physics, technique of application, forms of administration, indications and contraindications are covered. The work will be found valuable not only by those who themselves use this modality but by all physicians and surgeons who are called upon at various times to advise regarding its use. The author, who is Director of the Department of Physical Medicine at Temple University, is thoroughly conversant with his subject and at the same time conservative. The book in no sense holds a special brief for ultraviolet treatment in preference to other forms. It covers the subject rationally and emphasizes the contraindications quite as strongly as it does the indications. When the question comes up, "Will light therapy aid in this case?" Dr. Krusen's book is very likely to furnish the proper answer. Concise and yet complete with a list of over 100 references and a comprehensive index, the book may be highly recommended as an authoritative guide to this important subject.

INTRACRANIAL TUMORS. By Percival Bailey, M.D. Springfield, Ill., Charles C. Thomas, 1933.

As the author points out in his Preface, "These lectures are an amplification of demonstrations and clinics which I have given to my students at the University of Chicago and the illustrative cases are from my own clinic, with few exceptions."

The subject is comprehensively treated, the pathological symptoms are thoroughly discussed as well as operative technique. The bibliography is intended for supplementary reading only and is largely limited to English publications on the ground that American students do not read foreign languages. For a survey of the subject sufficient for the average physician and surgeon, this work may well be recommended.

THE NERVOUS CHILD AT SCHOOL. By Hector Charles Cameron. Oxford Univ. Press, 1933.

This book treats of a problem that faces every physician and surgeon. The subject is well treated and the author's point of view is thoroughly rational. Physicians and parents will both profit by the reading of this book.

AMERICAN AND CANADIAN HOSPITALS. A Reference Book Giving Historical, Statistical and Other Information on the Hospitals and Allied Institutions of the United States and Possessions, and the Dominion of Canada. Ed. by James Clark Field with the cooperation of the American Hospital Assn. Minneapolis, Midwest Pub. Co., 1933.

This book, published under the auspices of the American Hospital Association, is a volume of over 1500 pages, elaborately arranged. Under states will be found a listing of practically every

hospital of any standing in the United States and Canada with many of the details often looked for and hard to find, such as the kind of cases accepted, the number of beds available, the price per room, and such other information as is helpful in the selection of a hospital.

There is also given, in the case of the more important hospitals, a complete history of the hospital since its foundation and these histories have evidently been a matter of pride with the Editor for they are unusually well written and comprehensive. The story of Bellevue Hospital in New York takes up almost four pages and might well be accepted as a model in the clear and precise presentation of such a history.

Persons connected with hospitals and hospital work will find this book an indispensable work of reference and surgeons having occasion to recommend patients or to answer inquiries about hospitals outside of their own town will find in this volume just the information that they need to form a proper judgment as to the value of the hospital. As far as the reviewer knows, this information is not to be found in such detail in any other one volume.

The list of trustees of each hospital is given but the physicians in attendance are not. To find the physicians and surgeons connected with a hospital, reference must still be made to other works, but the staff of a hospital is apt to change and the inclusion of this list in this volume would render it out-of-date in short order, whereas the information contained therein is of permanent value. It may be looked upon as a work of reference for many years to come.

Its publishers have done their work unusually well, the paper is excellent, the typography, printing and binding leave nothing to be desired. The publishers and the Editor are to be congratulated on the production of an excellent and valuable work of reference.

INTERNATIONAL CLINICS. A Quarterly of Illustrated Clinical Lectures and Especially Prepared Original Articles. Edited by Louis Hamman, M.D. S. 43, vol. 1. Phila., J. B. Lippincott Co., 1933.

In line with the times, the *International Clinics* begins its forty-third series with a "new deal." A new Editor-in-Chief and a new Board of Editors graces the title page and, if the contents of the first number may be taken as an indication of what the future has to offer, this series should take on new life.

In this volume, there are thirteen articles covering medicine, surgery, neurology, pathology and recent progress in medicine and surgery. Each article is by an authority, well written, concise and to the point. For a rapid survey of the developments in medicine and surgery, this Quarterly is to be highly recommended and it is suggested that the possession of this series is one means of keeping our libraries up-to-date.

A COMPANION TO MANUALS OF PRACTICAL ANATOMY. By E. B. Jamieson, M.D. Ed. 3, London, Humphrey Milford, Oxford Univ. Press, 1932.

The third edition of this book has been brought up-to-date, the revisions relating particularly to the nervous system. Over 100 pages have been added. Printed in 6 and 8 point type on thin paper, this book of 654 pages practically fits into the pocket and may truly be called "multum in parvo."

For students, this book will be found indispensable and many a surgeon will save much time by having this book at hand as a memory jogger.

OPERATIVE SURGERY. By Warren Stone Bickham, M.D., and Calvin Mason Smyth, Jr., M.D. Volume VII, The Newest Operations, General Index to Complete Work, Vols. I–VII, Phila., W. B. Saunders Co., 1933.

Volume VII of Bickham's "Operative Surgery" with 765 illustrations carries on from where the complete system left off. Not its least attractive feature is the index of over 200 pages covering the entire seven volumes of the set. Spinal anesthesia, electrosurgery, and other advances made since the completion of the first six volumes of this series are well covered in this volume. The set may now be considered as rejuvenated and up-to-date.

THE RISE OF PREVENTIVE MEDICINE. By Sir George Newman, K.C.B., M.D., F.R.C.P., HON. D.C.L., LL.D. London, Humphrey Milford,Oxford Univ. Press, 1932.

In less than 300 pages, Sir George Newman has given us an interesting and splendidly written story of the development of preventive medicine from the days of primitive man to the

present. He has succeeded in making a splendid case for his thesis that "the triumphs of Preventive Medicine are . . . among the greatest achievements of the mind of man."

There are ten chapters covering the following subjects: Folk-lore, Magic, Custom, Religion, Egypt and the Mosaic Law, Greek Medicine and the Greek Spirit, How Greek Medicine Reached England, The Middle Ages and the Black Death, The Renaissance and the Rise of Physiology, Clinical Studies of Communal Disease, Pathology and Bacteriology, The Application of Discoveries, Collective and Communal Organization of Preventive Medicine.

A reading of this work cannot help but confirm the old adage that there is nothing new under the sun, for this work proves conclusively that preventive medicine, far from being a modern conception, has been in the mind of man since prehistoric times. A thoroughly interesting and worthwhile work which can be read to advantage by every physician and should be placed in the hands of every new graduate of medicine.

Surgical Pathology. By William Boyd, M.D. Ed. 3, Phila., W. B. Saunders Co., 1933.

The third edition of Boyd's "Surgical Pathology" published three years after the second edition brings the subject up-to-date and covers the ground thoroughly and completely. The subject of tumors and thyroid have been thoroughly revised. It is interesting to note the tremendous advances made in these and other surgical lines in only a few years.

The Principles of Treatment of Muscles and Joints by Graduated Muscular Contractions. By Morton Smart, M.D. Oxford Med. Pub., 1933.

According to the Foreword by Dr. William O'Neill Sherman of Pittsburgh the author of this book "was the first to advocate the treatment of injured joints, muscles, &c., by Graduated Muscular Contractions." The work covers the ground thoroughly and gives the detailed technique. For those interested in this method of treatment, this book is to be highly recommended.

Orthopaedic Surgery. By Walter Mercer, M.D. With a Foreword by John Fraser, M.D. Balt., William Wood & Co., 1933.

This book on Orthopaedic Surgery is a novelty in that it is written by a general surgeon and few will disagree with the author's dictum that "to become a good specialist one must first be a good general surgeon." While not as large and comprehensive as some of the American textbooks on Orthopaedic Surgery, this book will make a good reference work on the subject for the general surgeon. It is amply illustrated with halftones and line cuts. It is to be regretted that some of the former were not better reproduced.

Surgical Operations. A Textbook for Students and Nurses. By E. W. Groves, M.D. Ed. 3, Oxford Univ. Press, 1933.

The third edition of this text comes to us with minor changes which bring the work up-to-date. A thoroughly practical book for the operating room assistant. It represents the English point of view a little too closely for general acceptance in this country, but should make a valuable addition to the library of every hospital.

Roentgenographic Studies of the Urinary System. By William E. Lower, M.D. and Bernard H. Nichols, M.D. St. Louis, C. V. Mosby Co., 1933.

This interesting monograph would seem largely to duplicate and perhaps to some extent supplement the monographs by Braasch on "Urography" and Young and Waters' book on "Urological Roentgenology." It is interesting to note that the latter work is omitted from the authors' list of references. After a short text of 70 pages, which of necessity is of a sketchy nature, there follows the atlas section under the title "Roentgenographic Studies." There are 443 cases. There is a short description of the roentgen findings and, in some instances, a case history on the page facing the illustrations. In many of the cases, physical, urinary and cystoscopic findings are combined with the roentgen findings. In other instances, these are omitted. Young's method of presenting a more complete clinical history and clinical considerations of the case in connection with the roentgen findings seems to the present reviewer to be more

desirable.

In their Preface, the authors make a plea for greater cooperation between the urologist and the roentgenologist with which point of view everyone familiar with both subjects must be in complete accord. The authors also explain their lack of citations of other authors and give expression to a blanket appreciation of the work done by others on this subject.

In view of the limited text, it is felt that the value of the work would be enhanced by a more complete bibliography. The illustrations are fairly well reproduced but the typography leaves much to be desired.

INHERITED ABNORMALITIES OF THE SKIN AND ITS APPENDAGES. By E. A. Cockayne, D.M., F.R.C.P. Oxford Univ. Press, 1933.

This is a highly interesting monograph on a subject that has not yet been treated in book form. It will be of interest not only to dermatologists but to geneticists and all others interested in inheritance of abnormalities and of diseases, which today should be the concern of every practising physician and surgeon. This is truly an unusual book.

HISTORY OF UROLOGY. Prepared under the Auspices of the American Urological Association, Editorial Committee, Edgar G. Ballenger, William A. Frontz, Homer G. Hamer and Bransford Lewis, Chairman. 2 Vols., Balt. Williams & Wilkins Co., 1933.

The History of Urology, prepared under the auspices of The American Urological Association by an Editorial Committee consisting of Drs. E. G. Ballenger, W. A. Frontz, H. G. Hamer and Bransford Lewis, is another step forward in the much needed study of the history of the specialities of medicine. Volume I begins with the History of the American Urological Association, followed by seven chapters on the development of urology in the larger American cities. The balance of the work takes up the special diseases and instruments and is much more international in scope but the preponderating American influence in bringing urology to its present high position as a medical and surgical specialty is interesting to note.

The work will remain the standard source book on the subject for years to come. The American Urological Association is to be congratulated on this wonderful production and it is hoped that its example will be followed by other special societies.

OPERATIVE SURGERY. By Alexander Miles, M.D., and D. P. D. Wilkie, M.D. Oxford Univ. Press, 1933.

Like all attempts at condensation, this book with the impressive title of "Operative Surgery" which attempts in less than 600 pages to cover the entire subject, will find many critics, favorable and otherwise. The various chapters are excellently selected, well illustrated, and authoritatively treated. The omissions could be the subject of long discussions but it would hardly be fair to point them out.

The authors state that the work is intended "to provide for the needs of undergraduates who require a guide to their studies in the class of Operative Surgery and in the hospital, and of young graduates who may be called upon to undertake operative work as house-surgeons or in practice." Probably no two writers would agree as to just what was necessary to fill this bill. The authors have followed their own inclinations and have done their job well. They are to be congratulated on supplying a thoroughly practical and readable work. The typography follows the usual splendid style of the publishers.

A SHORT PRACTICE OF SURGERY. Vols. I and II. By Hamilton Bailey, F.R.C.S. and R. McNeill Love, F.R.C.S., M.S. (Lond.), London, H. K. Lewis & Co., Ltd., 1932.

In two volumes of 500 pages each, the authors have presented a thoroughly modern textbook of surgery confined to new and up-to-date material. As this is intended to be a thoroughly practical book, matters like historical data have been entirely omitted. By a very ingenious use of different sizes of types and headings, the material in this work has been made readily accessible for quick reference.

In the two volumes, there are over 600 illustrations of which 75 are colored. All of them are splendid and quite as practical as the text.

The authors have done an unusual thing in sticking absolutely to their point and avoiding all padding. The methods are those of the authors and of course, the English school predominates.

For a work of quick reference on modern surgery, these volumes will be handy to have within reach though where only a single text is available one that is more complete will be essential.

ACUTE INTESTINAL OBSTRUCTION

MONROE A. McIVER, M.D., F.A.C.S.

SEVENTH INSTALLMENT

PART II: DIAGNOSIS AND TREATMENT

CONTENTS

[This Number]

Chapter		Vol. XXI Page
XVIII.	Diagnosis: General Considerations	145
XIX.	Diagnosis (Cont.): Special Points & Differential Diagnosis	159

[Contents of Part I: The Disease]

		Vol. XIX
I.	Introduction	163
II.	General Considerations	172
III.	Varieties of Obstruction	191
IV.	Varieties of Obstruction (Continued): Bands and Membranes	365
V.	Varieties of Obstruction (Continued): Volvulus	378
VI.	Varieties of Obstruction (Continued): Intussusception	387
VII.	Varieties of Obstruction (Continued): Internal Hernias	581
		Vol. XX
VIII.	Varieties of Obstruction (Continued): Neoplasms	171
IX.	Varieties (Continued): Strangulated External Hernia	182
X.	Varieties (Continued): Occlusion of the Mesenteric Vessels	194
XI.	The Clinical and Pathological Picture: Morbid Anatomy	476
XII.	Clinical Pathological Picture (Continued): General Findings	483
XIII.	Clinical Pathological Picture (Cont.): Changes in Body Fluids	489
XIV.	Clinical Pathological Picture (Cont.): Mechanism of Cardinal Symptoms	500
XV.	Functional Obstructions	812
XVI.	Functional Obstructions (Continued): Varieties	823
XVII.	Functional Obstructions (Continued): Preventive Measures	833

PART II: DIAGNOSIS AND TREATMENT

Chapter XVIII

DIAGNOSIS

General Considerations

In approaching the question of the diagnosis of acute intestinal obstruction, it should be clearly borne in mind that if the life of the patient is to be saved, diagnosis must be made early in the disease. The terms "early" and "late" in the disease have a different significance according to their application to the fulminating or milder varieties of obstruction. Where strangulation is present, the lapse of twelve hours or less may be sufficient for irreparable damage to the involved intestine and for the development of serious systemic effects; while in simple obstruction of the colon several days may go by without the development of serious local or general effects. There are many variations between these two extremes. As pointed out by Eisberg,[1] even in strangulations there are considerable differences in the clinical course of the disease, depending on the length of loop involved and on whether the blood supply is suddenly or gradually occluded.

Diagnosis in the early stages of the disease is often difficult. This is demonstrated by the fact that although the symptom complex and major features of the disease have been taught to five or six generations of medical students and have been stressed at medical and surgical meetings for the past two or three decades, the patients continue to be brought to operation late and the mortality continues high. Modern laboratory diagnostic methods in general are not very helpful in arriving at a diagnosis of acute intestinal obstruction. The diagnosis must, therefore, rest on the old clinical basis of signs and symptoms; and yet the physical signs in the early stages of the disease may not be very constant. Muscle spasm and tenderness may be absent; visable peristalsis can be seen

only occasionally; abdominal distention may be absent or slight; the temperature and white blood count may be normal; and while the cardinal symptoms of abdominal pain, vomiting and obstipation are usually all present, they vary in intensity and prominence and are, of course, also associated with other diseases which do not demand operative interference. As a practical matter the real difficulty may be, not in diagnosing the presence or absence of obstruction, but in distinguishing between organic and functional obstruction. The two types may have many basic signs and symptoms in common, yet the former (organic) always demands operative interference, the latter only occasionally. The distinction is of particular importance in obstruction occurring during the convalescence from an abdominal operation, especially when peritonitis complicates the picture.

Study of the Patient

An intestinal obstruction may come on suddenly, with the patient in perfect health; or there may be a history of chronic obstruction before the acute attack. The symptoms are frequently severe from the beginning, although sometimes the onset is insidious. Where the pain is very intense, the patient may show some signs of prostration early in the disease; but usually this is not the case; the presence of this symptom early in the disease points to strangulation.[2,3] If the pain is extreme, the pulse-rate may be elevated; it usually, however, remains fairly normal until the late stages of the disease and then becomes rapid and thready.[4] The temperature is usually normal, or only slightly elevated. The patient frequently has a rather characteristic facial expression that might be described as one of anxiety. If there has been much loss of fluid by vomiting, the usual signs of dehydration (sunken eyes, dry tongue, depressed fontanelles in infants, and loose, inelastic skin) are present. The amount of urine passed is likely to be small, its volume furnishing some indication as to the extent of the dehydration.

In elderly patients, symptoms of abdominal distention, the peristaltic type of colic, and vomiting, suggest the possible diagnosis of obstruction from neoplasm of the colon. In these patients a past history can not infrequently be obtained of progressive constipation, bloody mucus in the stools, or frequent small movements, which tends to confirm the first impression. In infancy and early childhood, severe abdominal colic associated with a lack of bowel movements should suggest the possibility of intussusception; if bloody mucus is passed, the suspicion is greatly strengthened. Intussusception is outstandingly the chief cause of obstruction in infancy and early childhood, as is shown by the figures from children's clinics: Ladd and Cutler[5] reported 105 cases of obstruction in infants and children, of which 88 were caused by intussusception, and 17 by other conditions; Peterson[6] reported 55 cases of intestinal obstruction in the same age group, intussusception being responsible in 46 instances.

The presence of an abdominal scar in a patient with symptoms consistent with an acute obstruction should at least put the physician on his guard. Since abdominal laparotomies have become more common, postoperative intestinal obstruction is more frequently encountered.[7–9] This increase is shown in the following figures from the Massachusetts General Hospital: in the ten-year period 1898–1907 there were 37 cases of obstruction following early or late after abdominal operations; in the period 1908–1917, there were 57; in 1918–1927, there were 82. (See Table XVIII.)

In studying the patient suspected of having acute intestinal obstruction, particularly detailed information is needed on certain points, which are summarized below. Since, however, the suspected "intestinal obstruction" may prove actually to be lead colic, an abdominal crisis of tabes, or some other condition equally removed, a careful history that is not limited to the presenting symptoms, and a thorough and complete physical examination are required.

PRESENT ILLNESS

Abdominal pain: Location; duration; intensity; character (has it been cramp-like, "doubling-up"?). Periods of partial or complete remission? Diminishing or increasing in severity? Radiation?

Vomiting: Time of onset; frequency; character (accompanied by nausea? projectile?). Amount; appearance of vomitus (color and odor).

Bowel movements: Number since onset of illness; time of last movement; its character; did it contain blood or mucus?

Has gas been passed by rectum? How frequently? Have cathartics been given? What result? Have enemata been given? How many? What results?

Urine: Amount passed; has it been highly colored?

Distention: When first noticed? Has it been more severe than at present?

Medication: What kind? Morphia? Cathartics?

Diet: Solid food? Fluids? Retained?

PAST HISTORY

Previous abdominal operations: Date on which they occurred; character; was wound drained?

Question as to *existence of any hernia.*

Has patient had any *symptoms in the past* suggesting partial or complete obstruction, such as abdominal pain, vomiting, distention, excessive or unusual gurgling peristaltic sounds, constipation or diarrhea?

PHYSICAL EXAMINATION

General condition: Does patient appear acutely ill? Signs of collapse? Does he appear dehydrated (drawn features, sunken eyes, dryness of tongue)?

Abdomen: Flat? Distended? Uniformly so? Visible peristalsis? Tenderness, spasm or masses on palpation? Tympanitic; areas of dullness or flatness, or fluid wave on percussion? Peristaltic activity on auscultation normal? Increased? Absent?

Rectal examination: Masses? Tenderness?

LABORATORY STUDIES

Blood: Count of white blood cells, including differential count; non-protein nitrogen; blood chlorides.*

Urine: Usual examination.

X-ray: Examination (if indicated).

There are few diseases in which the classical signs and symptoms are all present in any individual case; and acute obstruction forms no exception to this rule. Pain, vomiting and obstipation are, however, so commonly encountered that they must receive special consideration.

* Not of much value in differential diagnosis; see page 154.

Analysis of Symptoms

Pain. Acute obstruction is usually ushered in by abdominal pain. This cardinal symptom is almost always present, although it varies considerably in character, severity and location. With simple obstructions of the small intestine it is colicky or cramp-like early in the disease and has a tendency to be intermittent, working up to a climax and then subsiding. After twelve to twenty-four hours the patient insists that the pain is constant, not coinciding with the waves of peristalsis which in some cases may be seen or heard at intervals. In obstructions of the large intestine the colicky character of the pain lasts longer than it does in obstructions of the small gut. Where strangulation exists, the infiltrated, distended loop of intestine causes pain that is steady and agonizing from the beginning, rather than colicky in character, and which may be of sufficient severity to bring on a state of collapse. In cases, where a chronic obstruction has been gradually converted into an acute obstruction, however, the pain may not be severe; and in certain types of obstruction (notably post-operative obstructions following serious operative procedures, or where peritonitis complicates the picture) pain may be absent, or if present may not be the most outstanding feature.

The location of the pain in obstructions of the small intestine is likely to be the region of the umbilicus or epigastrium. If the obstruction is situated in the colon, the pain is likely at first to extend across the lower abdomen, although in the early stages it may at times be referred to the epigastrium; when the obstruction has existed for some time, the pain is often localized over the site of the obstruction, probably because of edema and infection. If there is a strangulated loop of gut the pain may also be referred to the region overlying it. At times the patient is unable to localize the pain, passing his hands all over the abdomen when asked to show where it is.

VOMITING. Vomiting is present with the rarest exception and usually occurs very promptly after the onset of the obstruction. The amount of vomiting is likely to vary with the level of the obstruction and the stage of the disease. In general the vomiting is more frequent and profuse in high obstructions, particularly in the early stages of the disease; in the later stages it may take place frequently and in large amounts regardless of the level of the obstruction. In the later stages it may be observed that the patient goes for a number of hours without vomiting, and then, suddenly and with little vomiting effort, regurgitates a large amount of foul-smelling fluid from a dilated stomach. In these cases the stomach-tube is most useful in determining the true state of affairs.

The vomitus from obstruction presents no characteristic features in the early stages of the disease, consisting either of food recently eaten or of clear or bile-stained gastric juice. Later in the disease the vomitus does have characteristic and distinct qualities: it is a thin, yellowish fluid containing small whitish particles that settle out on standing; and the characteristic odor is foul in the extreme. This fluid represents the contents of the small intestine, although, of course, not the normal contents: it is a mixture of the secretions of the digestive glands and of the intestinal tract, which are poured out in great quantities under conditions of obstruction, and it is heavily infected with bacteria. It is this material which is usually described as "fecal" or "stercoraceous," receiving its name from the fecal-like odor imparted by the action of the colon bacillus and other putrefactive bacteria; it does not contain any actual feces, since true vomiting of feces is found only where there is a fistulous communication between the stomach and the colon.

Between the onset of the obstruction and the appearance of the characteristic vomitus, a time interval elapses, which in certain types of obstruction may be as long as several days; so that while inspection of the vomitus may confirm the diagnosis,

it may also indicate that the most favorable time for operation has passed.

Obstipation. Since complete intestinal obstruction necessarily stops the intestinal stream, it might be supposed that cessation of bowel movements and failure to obtain them after appropriate stimulation would be pathognomonic of the disease. The situation, however, is not quite so simple. If the patient is seen early after the onset of the attack, the fact that the bowels have not moved even with the use of enemas may not be conclusive evidence of obstruction: obstinate constipation and reflex inhibition of intestinal motility are findings not at all uncommonly associated with other conditions in which abdominal pain occurs, as, for example, renal colic. On the other hand, even though the bowels have moved after the onset of the pain, this is not conclusive evidence that obstruction does not exist. Failure to obtain even gas on the administration of subsequent enemas, however, is a finding that cannot be disregarded; and in conjunction with abdominal pain should suggest to the attending physician the necessity of at least placing the patient under surgical observation.[10]

In attempting to decide whether a partial obstruction has become complete, the question as to whether or not flatus has been passed is particularly important, since the patient with complete obstruction fails to expel even gas after the administration of an enema. If, however, vomiting and distention persist, and particularly if the character of the vomitus suggests intestinal contents, one should not be led into delaying operation too long because a little gas is being obtained on administration of an enema.

Physical Signs

The physical signs of intestinal obstruction may be pronounced in some cases, in others absent, or slight.

Distention. The most consistent physical finding is abdominal distention. Since it takes an appreciable length of time for fluid and gas to accumulate in sufficient quantities

to produce a demonstrable distention of the abdomen, this is not an early symptom unless there has been some chronic obstruction before the onset of the acute attack.

Distention does not always occur; it may be absent, or slight, when the obstruction is situated at a high level in the small intestine; and in certain cases of internal strangulation the whole course of the disease is so short and severe that there is not time for noticeable distention to occur. If, however, a case is seen late in the course of the disease, or if it has been improperly treated, the distention may be very great. It is seen in its most extreme degree where the obstruction is in the left side of the colon,[7] particularly where an acute obstruction is superimposed upon a chronic obstruction; and is also likely to be found in its severer forms where in addition to an organic obstruction there is a functional element introduced by peritonitis.

Muscle Spasm and Tenderness. The presence or absence of tenderness depends largely upon the type and duration of the obstruction. In strangulations, tenderness over the involved loop of bowel is frequently found early in the disease, particularly if the loop lies in contact with the abdominal wall. In cases of simple obstruction, tenderness and muscle spasm (abdominal muscles) are often absent early in the illness; usually, however, the abdomen is held rather tightly and some generalized tenderness is often present.* Codman[12] considers that the feeling of increased intra-abdominal tension obtained on palpation is quite characteristic. Later in the obstruction tenderness is present over the edematous, infiltrated loop of obstructed gut. In obstruction of the colon there is likely to be tenderness especially over the cecum.

In a recent series of 188 cases of intestinal obstruction[13] (obstructions by strangulated external hernia excluded) abdominal tenderness on palpation was recorded in 72 instances, muscle spasm in 41.

* According to Dr. D. F. Jones[11] the degree of tenderness also depends much upon whether or not the bowel is in spasm; when it is contracted the tenderness over it is marked.

Tumors. Occasionally it may be possible by palpation or percussion to detect a distended loop of gut (Wahl's sign); this finding, however, is infrequent.

In cases of intussusception it is fairly common in infants to be able to palpate the characteristic "sausage-shaped" tumor in the region of the cecum or ascending colon, or on the left side in the region of the descending colon or sigmoid. In the recent Massachusetts General Hospital series, out of 11 cases in infants, a mass could be palpated in 8 instances. This is in contrast with the group of older patients with intussusception, where a mass could be palpated in only one out of 6 cases. Occasionally the tumor produced by an enteric intussusception may be felt in other regions of the abdomen. On rectal examination it may be possible to palpate the apex of an intussusception.

Visible Peristalsis. Visible peristalsis can occasionally be made out above the point of obstruction. It was recorded in 27 of the 188 cases (obstructions from all causes except external strangulated hernia) recently reported by McIver.[13] It occurred with the greatest frequency in the early and late postoperative obstructions. Some of the most extreme examples are encountered not in complete but in partial obstructions. When the strangulation is present, peristalsis is not often visible.

Auscultation of the abdomen may yield evidence of increased peristaltic activity even when none is visible on inspection. In attempting to determine the existence of mechanical obstruction when peritonitis is present, the absence of any sounds of peristaltic activity is strongly suggestive that the symptoms of obstruction may be due to a paralytic distention of the intestines.

Clinical Indications as to the Level of the Obstruction

One is able not infrequently to draw inferences as to the level of the obstruction on the basis of the clinical picture presented. If there is no element of strangulation, the low obstructions run a milder course than the high obstructions.

In high blockage, the profuse, characteristic vomitus of obstruction comes on quickly and is an outstanding feature, so that these patients very rapidly show evidence of considerable dehydration; distention takes longer to develop and, indeed, may be slight even when the disease is advanced; the course of the disease is rapid and unless relief is obtained death is a matter of a few days.

Simple obstructions of the colon, on the other hand, may require a number of days before the disease reaches its maximum intensity. Vomiting is not so profuse in the early stages, and evidences of dehydration appear more slowly. Distention usually assumes marked proportions.

The clinical picture presented by patients with obstruction of the ileum usually lies somewhere between that presented by the high jejunal obstruction on the one hand, and obstructions of the colon on the other. In general it may be said that in simple obstructions the symptoms become less fulminating as one approaches the ileocecal sphincter.

Laboratory Studies

As already stated, laboratory examinations do not usually furnish a great deal of aid in establishing the diagnosis of acute intestinal obstruction. The blood chemistry findings early in the disease may be completely normal. So much has been written within the past decade on the low blood chlorides found in obstruction, that the impression may exist that this is a helpful diagnostic point. As a matter of fact, such is rarely the case. In the first place, since the low blood chlorides are the result of extensive vomiting, this finding is not present at the onset of the illness in any type of intestinal obstruction; and in the most common and fulminating types, in which strangulation is present, lowered blood chlorides may not be found at any stage of the disease. Furthermore, profuse vomiting occurs in connection with a number of diseases other than intestinal obstruction, and if it has been of sufficient amount will, of course, result in a lowering of the blood

chlorides*; so that however helpful the laboratory finding of a lowered blood chloride may be from the point of view of indicating the extent of the dehydration and the need for adequate administration of salt solution, it is only rarely that this finding is helpful in establishing the diagnosis. The same thing applies, with even more force, to an elevation of the non-protein nitrogen of the blood: it is true that after intestinal obstruction has become established the non-protein nitrogen is usually elevated; but, obviously, this finding occurs in a number of other diseases also.

The white blood count is frequently normal, especially in the early stages of simple obstruction. Where a strangulation is present the white count is likely to be high,[14] emphasizing the need for prompt operation.

X-ray Examination

Diagnosis by means of *x*-ray examination has a rather limited field in acute intestinal obstruction. Nevertheless, in certain cases it may be helpful. The administration of opaque substances by mouth for this purpose is highly dangerous, for it may convert a partial into a complete obstruction.† Roentgenograms following the administration of barium by enema will often establish or refute the diagnosis of obstruction of the colon; and while the barium enema may be a harmless procedure, if the patient is not in good condition it may overtax his strength and prove a needless waste of time. It has its greatest field of usefulness in subacute obstructions of the colon. X-ray plates of the abdomen taken without the administration of any opaque medium may furnish evidence of the existence of an obstruction, and, at times, may give some indication as to its level.[15–17] (Fig. 49.)

The diagnosis of obstruction of the small intestine by *x*-ray examination depends on noting collections of fluid and gas

* The digestive secretions may also be lost as a result of a severe diarrhea, and, in children particularly, a lowering of the blood chlorides may result from this condition.

† See March installment, p. 594.

in the intestines and the characteristic patterns they assume. In obstructions of the small intestine the accumulations of

FIG. 49. Intussusception in a child of three months. Barium enema, showing column of barium stopping in region of splenic flexure. Appearance of barium at region of point of stoppage suggests intussusception.

gas may give the outline described by Case[16] as the "herring-bone" appearance; or, at times, a "ladder" arrangement of

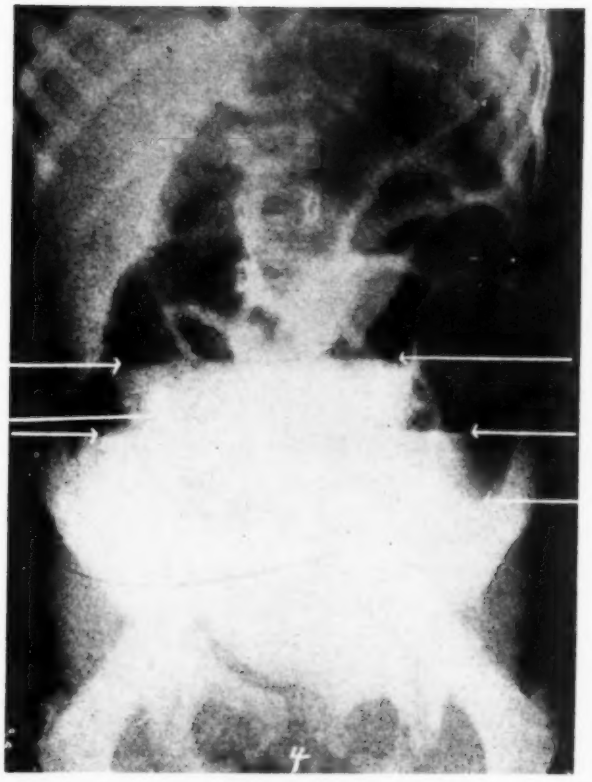

FIG. 50. Multiple fluid levels in acute obstruction; patient in upright position. (Ochsner and Granger.[15])

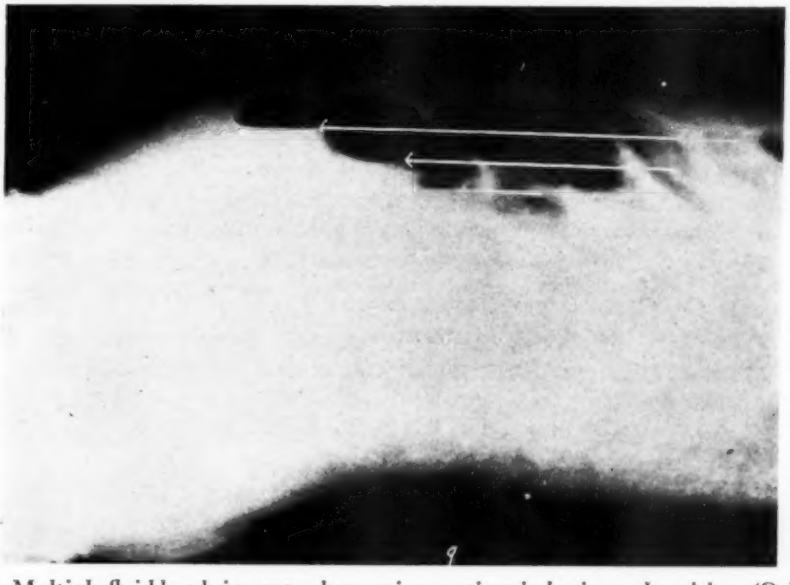

FIG. 51. Multiple fluid levels in acute obstruction; patient in horizontal position. (Ochsner and Granger.[15])

the dilated coils. The diameter of the dilated coils is also a point to note carefully, according to Case. The presence of various fluid levels in the obstructed bowel can at times be visualized. To bring this out, the roentgenograms must be taken with the patient in the upright position (either sitting or standing upright) or lying on the side, the picture being taken antero-posteriorly; or a lateral view may be taken with the patient lying on his back. Ochsner and Granger[15] have found the detection of multiple fluid levels a particularly important point in the diagnosis of obstruction. (See Figs. 50 and 51.)

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Chapter XIX

DIAGNOSIS (Continued)

In the previous chapter we have considered the cardinal signs and symptoms of acute intestinal obstruction. The clinical picture may be briefly summarized as follows:

The attack is likely to be ushered in by abdominal pain, of a colicky and cramp-like character at the onset, often becoming constant after the first twelve to twenty-four hours; and by vomiting, which becomes more profuse and persistent as the disease progresses, taking on the characteristics of "fecal" vomiting in the late stages. While the lower bowel may be emptied once after the onset of the attack, either voluntarily or by means of enemas, subsequent enemas usually fail to produce either fecal material or gas. Abdominal distention usually develops, although it may be negligible in amount if the obstruction be situated high in the small intestine. Visible peristalsis may occasionally be seen and in the presence of the symptoms already referred to is characteristic of the disease; but it is not present as commonly as one might suppose from the textbooks, and is rarely seen where strangulation exists. The temperature and pulse rate are usually normal, although not infrequently a subnormal temperature is encountered early in the disease.

While the foregoing picture is in general characteristic of acute intestinal obstruction, certain varieties of the disease present special clinical features, which will now be briefly discussed; certain points in differential diagnosis will also be considered.

Special Points in the Diagnosis of Certain Varieties of Obstruction

Early Postoperative Obstruction. The signs and symptoms of obstruction shown by the early postoperative group are in general those of acute obstruction from any cause:

vomiting, pain, distention and obstipation; but owing to the fact that these obstructions come on during a convalescence from abdominal operation, the picture is often masked. When the classical symptoms come on suddenly during a convalescence that is proceeding normally, the diagnosis is usually easy: the difficulties arise when the obstructive symptoms come on somewhat gradually during a stormy convalescence. The question often to be decided is whether the symptoms are due simply to a disturbance of the motor function of the intestine by operative trauma or peritonitis; or whether an organic obstruction is present.* The presence of cramp-like or colicky pains or visible peristalsis, or the detection of hyperperistalsis on auscultation, indicates that there is an attempt to push intestinal contents beyond some obstructed point, and suggests that some mechanical element is present. The character of the vomitus should be carefully noted and any change to "fecal" vomiting should be detected at the earliest possible moment. The amount of distention in these cases shows considerable variation: if the obstruction is high, it may be slight. Occasionally, localized distentions pointing to the presence of distended coils of bowel can be made out. A rising white count in the presence of obstructive symptoms is suggestive of strangulation.

The clinical variations shown by the obstructions that occur early after operation have been comprehensively discussed by Richardson.[4]

Volvulus. Volvulus of the small intestine cannot usually be distinguished from any of the other forms of internal strangulation of the small intestine.

* The use of spinal anesthesia has been suggested for the differential diagnosis between functional and mechanical obstruction. Following the administration of spinal anesthesia in functional obstructions a movement of the bowels and passage of flatus may occur. The advocates of this procedure advise prompt operation if this favorable result does not take place.[1] The possibility that violent peristaltic movements set up by the spinal anesthesia may produce rupture of a gut damaged by obstruction, should be borne in mind.

In connection with the use of spinal anesthesia, Ochsner's work on splanchnic anesthesia in the treatment of experimental ileus is of interest; and numerous references to the literature on this subject will be found in his articles.[2,3]

Volvulus of the sigmoid at times has more distinctive features. In general it occurs in middle age or later. Not infrequently there is a history of obstinate constipation preceding the attack; it is also not uncommon to have a history of attacks in the past that suggested obstruction but were milder in character and subsided after the administration of enemas.[5,6] The pain and tenderness are likely to be localized in the left lower portion of the abdomen; the pain may be intense and associated with considerable prostration.[7] At times a mass can be made out, its outline corresponding with the dilated loop of sigmoid. A barium enema may show the point of obstruction.

In volvulus of the cecum also there may be a history of earlier attacks[8]; and at times a mass, representing the twisted cecum, can be made out in the right side of the abdomen.

GALLSTONES. As would be expected from the etiology, this type of obstruction is a disease chiefly of later life.[9] It is one of the few types of obstruction that is more common in females than in males. The obstruction may be complete from the beginning; or there may be a subacute period before the intestine is completely blocked. The severity of the symptoms varies, depending in part upon whether the gallstone has become impacted in the upper intestine, or, as more frequently happens, lodges near the ileocecal valve. In the early stages the pain is usually colicky in character and referred to the umbilicus. Not infrequently a history that suggests gall-bladder pathology can be obtained.[10,11] Occasionally upper abdominal pain, nausea, vomiting and tenderness, corresponding with the discharge of a gallstone into the upper intestinal tract, may have preceded the obstructive symptoms. At times an *x*-ray of the abdomen may show the presence of a gallstone; and, rarely, the passage of gallstones by rectum may be reported.

Essentially, the diagnosis of obstruction by gallstones should be suggested by obstructive symptoms developing in an elderly individual whose past history indicates gall-

bladder disease. The common cause of obstruction in this age group is carcinoma of the colon; but in this latter disease there is usually a history of increasing constipation, or of frequent small movements, at times containing blood and mucus, preceding the acute attack. The distention is likely to be more marked than in obstruction by gallstones.

MESENTERIC THROMBOSIS. The diagnosis of occlusion of the mesenteric circulation by thrombosis or embolism is difficult, and is often made only at operation or autopsy: in Trotter's[12] series of 360 cases, the diagnosis was made before operation or autopsy in only 13 instances. There are, however, certain points which may suggest the diagnosis.

While the disease may occur at any age, even in childhood, it is more commonly a disease of later life. It is usually associated with some disease of the circulatory system, such as endocarditis, atheroma of the aorta or arteriosclerosis; and the patient may give a history of embolic phenomena in other parts of the body before the onset of the abdominal symptoms or simultaneously with it. There are also other diseases with which it is sometimes associated: Meyer[13] reports that it occurred in 3 patients with polycythemia.

The classical signs and symptoms are severe abdominal pain,[14] vomiting, melena, distention of the abdomen with tympanites and at times a shifting dulness in the flanks. If the bowels move after the onset of the attack, the feces may contain blood. This finding was present in 41 per cent of the cases reported by Jackson et al.[15] When the process of infarction involves the upper intestine, the vomiting of blood has been reported. The patient may show signs of collapse,[16] with a fall in body temperature. A low pulse rate is sometimes found at the onset of the attack.[17] The leucocyte count is likely to be quite high: in the series of 92 cases collected by Meyer[13] the count in all but 3 instances was above 18,000, the highest being 45,000.

OBSTRUCTION OF THE COLON BY NEOPLASM. The symptoms of obstruction of the colon from neoplasm have a tendency to

be less fulminating than if the obstruction were located in the small bowel. Symptoms of subacute obstruction (usually increasing constipation, or in certain cases frequent small watery movements occasionally mixed with blood or mucus, cramp-like pains radiating across the lower abdomen, increasing gurglings of gas and fluid and a sensation of inability to empty the bowels,[18,19]) are likely to antedate the acute attack.

Since strangulation is very rarely present in these obstructions, the pain may not be particularly severe. It is, however, almost constantly present. In the early stages it is usually localized across the lower abdomen; when the obstruction has existed for some time, the pain and tenderness are often localized over the site of the obstruction, probably because of edema and infection. In some instances acute discomfort from distention is the most outstanding complaint. Vomiting comes on early with the onset of the acute attack, but is not likely in the early stages to be so profuse or frequent as in obstructions of the small intestine; in the later stages, after the obstruction is well established and as the small intestine becomes more and more involved in the obstructive process, the vomiting may be profuse and of the typical "fecal" character. Distention is likely to be a very marked feature. In the early stages, visible peristalsis of the large intestine above the point of obstruction is not infrequently seen. Rectal examination is important and may disclose a mass, particularly when the growth is situated near the rectosigmoid juncture.[20]

In an attempt to say whether or not an obstruction is complete, the passage of flatus either voluntarily or on the administration of an enema is an important criterion. The vomitus should be carefully observed; if it takes on the character of small intestinal contents, prompt surgical intervention should be undertaken even though some flatus is being passed by rectum.

There is usually little or no systemic reaction, the temperature and white blood cell count being generally normal.

X-ray examination following the administration of a barium enema is often helpful.

STRANGULATED EXTERNAL HERNIAS. The diagnosis in cases of strangulated external hernia is usually obvious. In typical cases, a hernia which has previously been reducible becomes irreducible. This condition is accompanied by severe, often intense, pain, which may not be confined to the hernial sac but may take the form of generalized abdominal cramps. Vomiting is usually present, starting soon after the initial pain. Obstipation is usually present; although early in the illness the bowel below the point of obstruction may be emptied voluntarily or by means of an enema, and in types of hernia where a section of bowel wall alone is strangulated, without obstruction of the lumen (Richter's hernia), bowel movements may continue throughout the course of the disease. Under these conditions, diarrhea is not infrequent.

The late manifestations are those usually found in acute intestinal obstruction from any cause: distention, fecal vomiting and prostration.

Although the diagnosis is usually so easy, there are occasional cases where it is not obvious. The patient may not be aware that he has a hernia, and a small, tense sac may be overlooked, particularly if it occurs in the femoral canal. In the recent Massachusetts General Hospital series of 147 cases of obstruction by strangulated external hernia, there were 3 instances in which the diagnosis was not made until laparotomy had been performed and a knuckle of gut found strangulated in the femoral canal. In any patient with symptoms suggesting intestinal obstruction, the usual sites of hernia should be carefully examined to exclude the possibility of a small, strangulated hernia.

INTUSSUSCEPTION. Most of the cases of intussusception occur in infants or young children, frequently at an age when the patient is unable to describe his symptoms. With the onset of the attack the infant is likely to show unmistakable signs of abdominal pain, at times drawing up the legs and crying

as the cramp-like pain takes place. Vomiting frequently takes place at the onset of the obstruction and is likely to be repeated; it may not be very profuse. Often the pain is considered to be one of the commoner varieties of intestinal colic and there is delay in calling the physician; or at times the physician prescribes for the infant over the telephone without a physical examination.

After the onset of the attack there may be one normal bowel movement; after that, the passage of bloody mucus occurs and is a very constant symptom in infants.[21–23] The infant may lie in a rather apathetic state, showing evidence of marked toxemia; other signs of prostration may occur relatively early in the disease. On the other hand, even after a number of hours have elapsed he may not show a great deal of systemic reaction. On physical examination there is usually not a great deal of distention, and in the classical case a "sausage-shaped" tumor may be felt in the right or left side of the abdomen; at times, however, the intussusception is under the lower border of the liver and no mass can be felt. On rectal examination it is often possible definitely to palpate the apex of the intussusception.

The syndrome shown by infants with intussusception is usually so typical that it seems almost incredible that cases should so often come to the surgeon late. Among the 9 deaths from intussusception in the series recently reported from the Massachusetts General Hospital there were only 2 patients who were received at the Hospital in less than forty-eight hours after the onset of symptoms. This group of obstructions seems to be outstandingly one in which the general practitioner can contribute to a lowering of the mortality by sending the patients to the surgeon earlier.

While intussusceptions occurring in infants and young children are usually of the ileocecal or ileocolic variety (involving both small and large intestines). The rare cases of intussusception in adults are likely to be of the enteric variety (involving the small intestine alone) or the colic (involving the large intes-

tine only), and are usually caused by a benign or a malignant tumor[24]; this latter is usually encountered in elderly individuals. In adult patients the clinical syndrome is not so typical as in children. There are frequently attacks of abdominal pain preceding the final attack. With the acute attack, vomiting and pain are present; distention is usually not marked; bleeding from the rectum is infrequent; and an abdominal tumor is only occasionally felt. From the general symptoms, however, in spite of features which are not typical of intussusception in infants, it should be easy to realize at least that an acute obstruction is present and that operative interference is indicated.

There is a relatively rare disease, namely, purpura abdominalis or Henoch's purpura, which may be confused with intussusception because in this disease also there are frequently abdominal cramps associated with the passage of blood by rectum. Other signs of purpura, such as the rash over the abdomen and the petechial hemorrhages that may follow after the application of a tourniquet (the "tourniquet test"), may clarify the diagnosis. Even if it proves to be purpura, however, the question of intussusception may still be involved, for, as pointed out by Bailey,[25] the hemorrhagic infiltration of the wall of the small intestine often taking place in purpura may result in intussusception. Bailey reports 9 cases where this occurred, with 7 recoveries following operation. In cases of doubt an exploratory laparotomy should be carried out.

Differential Diagnosis

Diseases that may be confused with acute intestinal obstruction are in general those that give abdominal pain and at the same time cause interference with intestinal motility. The list of diseases having a symptom complex which may, at least in part, resemble that of acute obstruction, is rather long and heterogeneous; a few outstanding examples of different types may be mentioned and briefly commented upon.

Among the more general constitutional diseases that may have abdominal symptoms of sufficient prominence to be confused with intestinal obstruction, should be mentioned lead colic, the gastric crises of tabes, and uremia. It should not be forgotten that pneumonia and cardiac thrombosis are capable of causing severe upper abdominal pain which may be accompanied by nausea and vomiting. Among the rarer medical conditions that have been mistaken for obstruction, Treves[26] mentions cholera and poisoning by arsenic. Angioneurotic edema may at times cause intense abdominal pain, nausea and vomiting; Osler's article[27] and Withington's[28] on this disease are very interesting.

The differential diagnosis depends upon finding in the course of the history and physical examination, clear evidence that some disease other than intestinal obstruction is responsible for the symptoms: for example, the fixed pupils and absent knee-jerks of tabes, the lead line on the teeth in lead poisoning, and so forth.

The pain associated with the passage of a calculus, either biliary or renal, may be mistaken for the colic of intestinal obstruction. Usually the characteristic location and radiation of the pain in these conditions,* or associated findings such as blood in the urine or at times slight jaundice, will serve to establish the correct diagnosis.

The following case illustrates the symptoms of obstruction associated with the passage of a renal calculus:

Case xxxiii. No. 5317, MIBH. Female, aged fifty-eight. The patient was sent to the hospital with a diagnosis of acute intestinal obstruction. She gave a history of four days of abdominal pain, profuse vomiting, and cessation of bowel movements. The pain was located in the left lower side

* The characteristic pain of gallstones is, of course, likely to be located in the right upper quadrant of the abdomen and frequently radiates through to the back, especially to the "shoulder blade." The pain of renal colic may be localized largely in the region of the costovertebral angle, in which case it is not likely to be mistaken for intra-abdominal pathology; where the pain is felt in the abdomen it is likely to be localized in one side of the abdomen or flank and radiate downward to the scrotum or penis in the male or the vagina in the female; the pain may be referred down the thigh on the affected side. Contrast the pain in these conditions with the pain in intestinal obstruction (see p. 149).

of the abdomen and flank, and radiated to the left inguinal region; it had been very intense at times and paroxysmal in character. The vomitus had not been foul smelling at any time. The patient had been well and strong during her past life, "had never had a doctor." A number of years before, she had had an attack of left-sided abdominal pain resembling somewhat the present attack but shorter in duration and less severe in character.

Physical examination showed an obese woman with some abdominal distention. She complained of pain in the left side of the abdomen, but stated that it was not as severe as it had been previous to entrance. There was no muscle spasm; definite tenderness over the left side of the abdomen and in the left costovertebral angle. It was noted on examination of the extremities that the patient held the fingers somewhat tense; the thumb was in the abducted position. On applying the tourniquet to the arm (Trousseau's test) the typical carpal spasm of tetany occurred. Temperature 101.6°F., pulse 96, respirations 22; white blood count 6000, polymorphonuclear leucocytes 81 per cent, small lymphocytes 16 per cent, large lymphocytes 2 per cent, mononuclear leucocytes 1 per cent. Examination of the urine showed a faint trace of albumin, a few red cells and a few white blood cells. The blood chlorides were 495 mgs. per 100 c.c.

The unilateral nature of the pain, with the radiation to the left inguinal region, suggested the diagnosis of renal colic. When the urine was found to contain red blood cells, this impression was strengthened. A roentgenogram of the abdomen showed a shadow in the course of the left ureter that was characteristic of a calculus. This was later confirmed by a cystoscopic examination. Within the course of a few days the patient passed the calculus.

Comment: The fact that the patient's pain and tenderness were largely confined to the left side of the abdomen and flank, together with the characteristic radiation of the pain, was very suggestive of some lesion of the kidney and ureter. As has already been pointed out, functional disturbances of the gastrointestinal tract are not uncommonly associated with such pathology. In this case they were marked, particularly the vomiting. The gastric secretions had been lost to such an extent that gastric tetany occurred: this is not infrequent in organic obstruction at the pylorus; but it is rare that the vomiting in cases with no organic obstruction is sufficient in amount to produce this result.

The distention yielded to the simple measures of flaxseed poultices and rectal tube. Large volumes of normal salt solution were administered to the patient subcutaneously. The vomiting subsided, as did likewise the signs of gastric tetany. No operative procedures (other than cystoscopic examination) were required.

Various acute conditions arising in the abdominal cavity cause a sudden onset of intense pain, nausea and vomiting, and may resemble the picture of intestinal obstruction with strangulation. Among these may be mentioned the twist of an ovarian cyst or of a pedunculated fibroid, the perforation of an ulcer, acute pancreatitis, etc. Rarely, the intensive colic accompanying the onset of a fulminating appendicitis might be confused with the pain from an obstruction, but usually the localized tenderness and other findings will clear up the diagnosis. Frequently in this group it is not possible to make an accurate differential diagnosis; but it is usually clear that prompt surgical intervention is indicated, whatever the diagnosis, and operation should not be delayed. In the following case certain symptoms of obstruction were associated with acute appendicitis and general peritonitis:

CASE XXXIV. No. 8124, MIBH. Male, aged forty-nine. The patient was sent to the Hospital with a diagnosis of intestinal obstruction. About two weeks before this he had had an attack of abdominal pain, extending across the lower abdomen, which persisted for about twenty-four hours. The pain was somewhat colicky in character, but was dismissed by the patient as "indigestion." Four days before admission the pain recurred; the patient took several doses of cathartic without relief of the pain and with little fecal result. Two days before admission he woke from sleep with a very severe pain across the lower abdomen; a physician was called and morphine was administered hyperdermically; the patient vomited several times. Since that time the patient has had little pain, but marked distention of the abdomen; there have been no bowel movements and enemas have produced only a small amount of gas. The patient was known to have had diabetes and nephritis for a number of years.

Physical examination showed a moderately obese man with distention of the abdomen; he was having no pain. On palpation there was slight tenderness on deep pressure over the right lower quadrant; over this region there was definite muscle spasm. Rectal examination was not remarkable. The patient was sweating profusely. Temperature 101.2°F., pulse 116, respirations 24, white blood count 14,000, with 90 per cent polymorphonuclear leucocytes. The urine showed heavy traces of albumin and sugar, with many hyaline and granular casts, few white blood cells, a rare red blood cell; diacetic and acetone were present in large amounts; the blood sugar was 235 mgs. per 100 c.c.

Although this patient did have certain signs of intestinal obstruction (cessation of bowel movements and essentially negative results from enemas, together with abdominal pain and vomiting), it seemed reasonably certain that these signs were not primary, but were secondary to an inflammatory process within the peritoneal cavity. The history, together with the elevation of the temperature and the leucocytosis, abdominal tenderness and spasm, all pointed to this diagnosis.

The patient was intensively treated for a few hours by insulin and intravenous administration of solutions of saline and glucose, by the medical department. Under this regime the blood sugar was lowered and the acetone and diacetic disappeared from the urine. The abdomen was then explored under novocaine and gas anesthesia. A ruptured appendix and general peritonitis were found. The appendix was removed and a drain inserted. The patient's general condition became progressively worse, and he died on the second postoperative day, with marked elevation of pulse, temperature and respiration. There was no vomiting following the operation and the abdominal distention diminished somewhat.

Comment: This case represents a functional disturbance of intestinal motility from peritoneal sepsis. The diagnosis was reasonably clear. The functional obstruction really played no important role in the picture, the patient dying of a progressive peritonitis.

The distention and obstinate constipation shown by patients with Hirschsprung's disease may at times suggest obstruction; in case of doubt, a barium enema will show the true state of affairs.

Fecal impaction in the rectum in the aged may at times reach such proportions as to constitute a temporary obstruction. The obstruction, however, is rarely complete, and a rectal examination and enema will usually settle the question.

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